NEW YORK INDEPENDENT SYSTEM OPERATOR

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Blackout August 14, 2003 Final Report

February 2005

Final Report:

On the August 14, 2003 Blackout

February 2005

Acknowledgments

The NYISO would like to acknowledge the NYISO Restoration Working Group, all Transmission Owners (TOs), Generators, the New York Department of Public Service (NYDPS), the Northeast Power Coordinating Council (NPCC), and the New York State Reliability Council (NYSRC), for the cooperation and assistance that individuals gave during the process of evaluation, understanding and action following the 2003 Blackout.

Finding the cause of the power outage occurred fairly quickly subsequent to the August 14, 2003 event. It was analyzing the system disturbance, collecting the data, developing models of the precursors to the event and evaluating reliability that took time.

The NYISO published our Interim Report on the blackout in January 2004. We have been working diligently since that time to continue to thoroughly investigate all aspects of this occurrence.

This report includes New York's response to the event, various computer simulations of the event, and possible physical and/or procedural improvements to the New York system.

All of these findings would not have been possible without the expertise, knowledge and countless hours of work by members of the Restoration Working Group, the NYISO operators, engineers, IT professionals and many others including consultants.

Establishing a factual, historical record of this event is vital for the future of this industry and we express our deepest gratitude for all of those dedicated to this mission.

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1. Executive Summary

The NYISO, in conjunction with its Transmission Owners (TOs), Generators, the New York Department of Public Service (NYDPS), the Northeast Power Coordinating Council (NPCC), and the New York State Reliability Council (NYSRC), has been conducting an extensive evaluation of the blackout event. This evaluation includes New York's response to the event, various computer simulations of the event, and possible physical and/or procedural improvements to the New York system.

The U.S. Canada Power System Outage Task Force (the International Task Force) concerning the August 14, 2003 Blackout undertook a comprehensive, eight-month investigation of the day's events, and issued its final report in April 2004. The report identified the root causes of the event, which included a number of NERC reliability rule violations, and recommended 46 specific actions for industry participants and regulators to implement. Other related investigations and audits of the blackout have been conducted, which have provided additional information and recommendations. The NYISO continues to support and participate in these investigations.

This report is the NYISO's final report on the August 14, 2003 Blackout. It succeeds an interim report, which was issued by the NYISO in January 2004.

The Event

August 14, 2003 was an unremarkable summer day where, until shortly after 4 p.m., the power system was secure and operating normally in New York. All bulk power system transmission was in service except for the outage of the Linden Goethals 230 kV transmission line, which resulted from a previous fault. There was a generation capability surplus of approximately 3,000 MW. Normal levels of operating reserves had been maintained throughout the day. Power flow transfers on both internal and external transmission interfaces were within prescribed limits and the bulk power system cross-state voltage profile was within normal operating limits.

The NYISO had not received notifications or advisories from other control areas and, unfortunately, had no awareness of the precursors to the blackout.

- At 4:06 p.m., there were small (approximately 100 MW) but increasing power shifts into New York from PJM and out to Ontario.

- At 4:09 p.m., the NYISO noted a larger power swing of approximately 700 MW out to Ontario, as well as a coincident swing of similar proportion from PJM into the NYISO.

- At 4:10:39 p.m., a sudden power swing, estimated to be approximately 4,000 MW, entered the NYISO system from PJM, and traveled westward into the Ontario system. Within six seconds, the ties between PJM and NY tripped.

In the next 3 seconds the upstate ties with ISO New England ("ISO-NE") opened, followed immediately by the severing of the NY Total East interface. As a result, the NYISO system separated into two electrical islands and western New York separated from the Ontario system just west of Niagara Falls, Ontario.

Severe frequency oscillations in the western island caused the large nuclear and combined cycle

units in the Oswego area to trip. Some of the fossil generation tripped by relay protection, and in other cases operators took the units off-line because they were becoming thermally unstable. This operator action enabled the quick restart of these units during the restoration process. The western New York island stabilized and survived with an approximate balance of load and generation of 5,700 MW.

The eastern island, including the Hudson Valley, New York City, and Long Island, was unstable because of a severe imbalance of load and generation. Contributing to the generation deficiency were over 2,100 MW of unsupported load in the northeastern portion of the PSE&G and Rockland Electric (New Jersey) areas, and over 1,100 MW of unsupported load in southwestern Connecticut, which remained electrically connected to the eastern island of New York. While under-frequency load shedding protection systems operated properly, the eastern island could not survive with a generation deficiency of nearly 7,000 MW. By approximately 4:20 p.m. the eastern island was effectively blacked out. In total, 22,984 MW of New York load was lost.

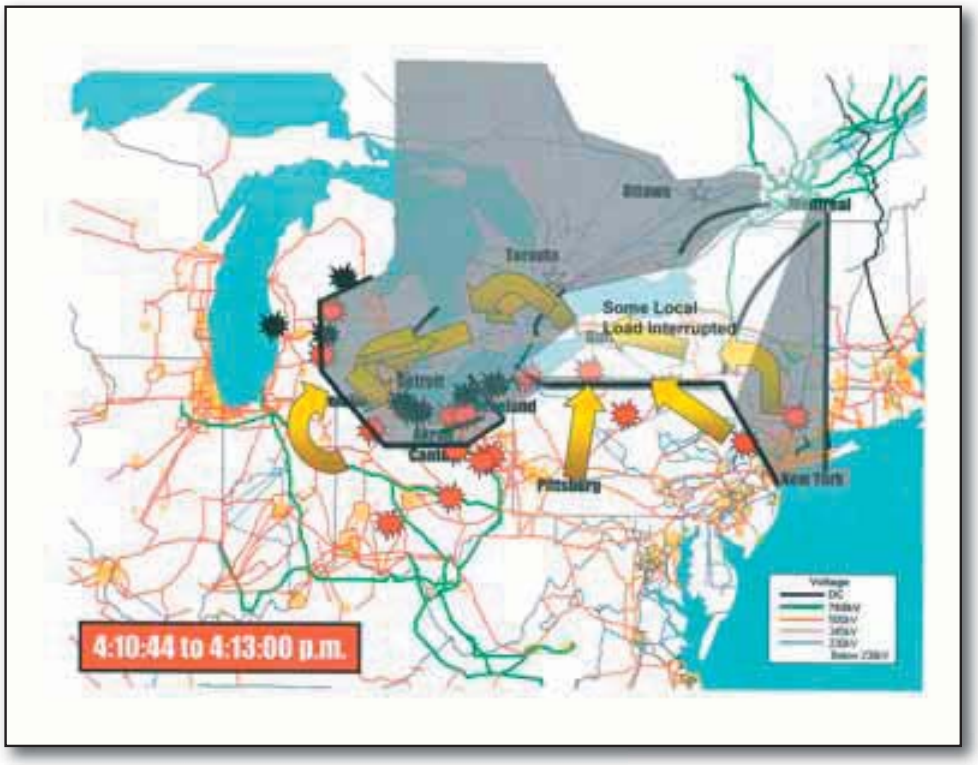
The Markets

Prior to 4:00 p.m. on August 14, 2003, the New York wholesale electricity markets, including the Day-Ahead and Real-Time Balancing Markets, were operating normally. Day-Ahead Market operation for Thursday the 14th and Friday the 15th had been completed normally before the time of the system disturbance. Day-Ahead Market operation for Saturday the 16th and Sunday the 17th continued to operate normally during the restoration period. The Real-Time Market was suspended immediately following the Blackout. Normal Real-Time Market operations recommenced on Monday the 18th.

The NYISO implemented existing tariff provisions for the settlement of the markets in emergency situations, and carried out these settlements in cooperation with Market Participants. The necessary adjustments were successfully incorporated in the August invoices.

The blackout and subsequent system restoration caused a number of Market Participants to incur

Figure1.1. Map of outage areas.



expenses while following the NYISO's instructions, for which there is no market recovery mechanism. Following the recovery, the NYISO set up a process to review and, where appropriate, compensate Market Participants for these "extraordinary costs" to ensure that Market Participants were not financially harmed for following the NYISO's instructions and expediting the restoration of service to New York's consumers.

Restoration

The NYISO has an extensive restoration plan which is tested and simulated on a regular basis. Because of these factors the execution of this plan allowed electric service to New York's customers to be restored in under 30 hours following the blackout. Coordination between the NYISO, New York's Generators, Transmission Owners, and neighboring electric systems was outstanding.

The NYISO and New York's TOs conducted a comprehensive review of the restoration effort, and published their findings in a June 2004 report.

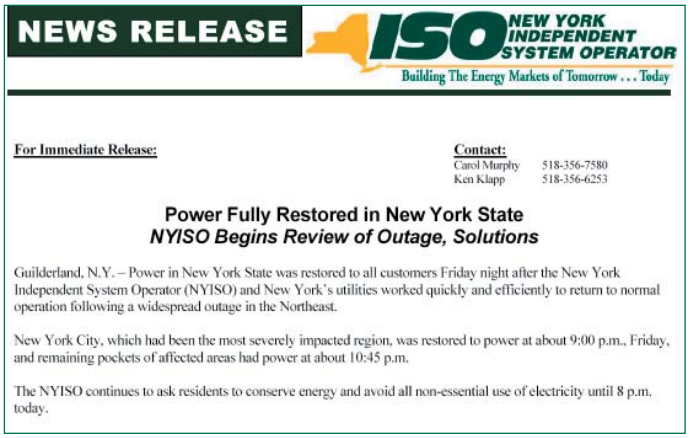
Major recommendations for restoration included:

- Establish a "command post" location at each control center to be dedicated for events similar to this that require phone centers and map boards for non-dispatch staff to coordinate activities off the dispatch floor.

- Investigate the establishment of a formal process for disseminating system information to the Transmission Owners and the generation owners during a system disturbance, enhancing the current procedures.

- Develop presentation materials and exercises on the TOs' restoration plans for the instruction of generators in their areas and the NYISO Operations staff, with due consideration to security issues.

The Bulk Power System Restoration Report is included in Section III of this report.



NEWS RELEASE

NEW YORK INDEPENDENT SYSTEM OPERATOR

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Power Fully Restored in New York State
NYISO Begins Review of Outage, Solutions

Guilderland, N.Y. – Power in New York State was restored to all customers Friday night after the New York Independent System Operator (NYISO) and New York's utilities worked quickly and efficiently to return to normal operation following a widespread outage in the Northeast.

New York City, which had been the most severely impacted region, was restored to power at about 9:00 p.m., Friday, and remaining pockets of affected areas had power at about 10:45 p.m.

The NYISO continues to ask residents to conserve energy and avoid all non-essential use of electricity until 8 p.m. today.

Actions Taken for Summer 2004

The NYISO, in conjunction with its Market Participants and working with the North American Electric Reliability Council (NERC) and NPCC, also undertook a number of improvements for the summer of 2004 in order to reduce the likelihood and/or severity of events such as August 14, 2003.

Event Analysis & Modeling

The NYISO is extensively involved in the extremely difficult dynamic modeling of the August 14th event with the Canada – U.S. Joint Task Force, NERC, and NPCC Investigation Teams. While the complete analysis is not yet available, the details of the sequence of events leading to the formation of the islands and subsequent collapse of the eastern island are presented in Section II. Reconstruction of each step in the sequence and evaluation of the step-by-step simulation of the entire mechanism of the collapse is targeted for completion in 2005.

While the simulation of the complete cascade event is being developed by the NERC and Interregional Investigation Teams, NPCC and NYISO staff performed several limited scope analyses or "what if" tests to gain additional insight into and evaluate aspects of the failure. These "what if" analyses are preliminary evaluations and do not account for all of the dynamics that occurred. The results suggest possible areas for future study, but are not themselves indicative of system design weakness.

The Importance of Mandatory Standards

There are no national mandatory reliability rules or standards in the United States. Even though operators in New York, New England, and Ontario are obligated to follow NERC and NPCC standards by agreement and contract, the failure of a distant system to follow the rules can have catastrophic consequences hundreds of miles away.

Virtually all responsible parties, utilities, ISO's and RTO's, DOE, FERC, NERC, state commissions, and federal and provincial legislators in the United States and Canada agree that the root cause of the blackout was the failure to adhere to the existing reliability rules. The NYISO believes that the rules must be made mandatory on all participants in the interconnected system.

Conclusion and On-going Work

The Northeastern U.S., including New York State, did not initiate or contribute to the Blackout of 2003. It is clear that the magnitude of the power swings that occurred during the "final cascade" of the sequence was substantially beyond anything the system was designed to withstand.

New York's electric system functioned as well as could be expected under the circumstances, and the restoration of service following the blackout was rapid.

The NYISO and its Market Participants, the NYDPS, and the NYSRC will continue to refine their analyses of the event in order to factor the lessons derived from this experience into New York's system design criteria, operating procedures, and restoration plans.

2. The System Disturbance

Six major components of system disturbance included in this section:

- NYISO Pre-Disturbance System - Progression of Disturbance outside of the NYISO:
  - o Prior to 16:10:38
- Loss of PJM-NYISO Ties
  - o New York – PJM separate 16:10:45.
- Loss of ISO-NE – NYISO Ties
  - o New York – New England separate 16:10:47
- Separation of New York Total East Interface
  - o New York separates along Total East interface 16:10:49
- Separation of Southwest Ontario from NY
  - o Ontario separates west of Niagara Falls 16:10:50
- Collapse of Eastern-New York Island
  - o Southwest Connecticut separates from New York 16:11:22

A detailed sequence of events is available in Appendix A

As a result of the investigations conducted by the Joint U.S./Canada Task Force ("Task Force"), it is now evident that a series of events in northern Ohio that began earlier in the day resulted in a rapid succession of severe power swings and voltage and frequency oscillations that caused the near collapse of the system in New York and Ontario, and most of eastern Michigan and northern Ohio. The disturbance also affected parts of northwestern Pennsylvania, northeastern New Jersey, and southwestern Connecticut. This report relies on the description of events in the report of the Task Force. Since that report has been widely distributed, this Final Report will not repeat the details of the Task Force report except to the extent necessary to understand what occurred in New York.

At approximately 16:10:38 a sudden power swing, estimated to be in excess of 3,500 MW, entered the NYISO system from PJM, and passed through New York, and westward into the Ontario system at Niagara.

With the final separations in Michigan and the loss of the Erie West – Ashtabula line, the FirstEnergy and Detroit Edison systems were then only connected to the Eastern Interconnection through the Michigan – Ontario ties and the Ontario system to the NYISO. This instantaneously caused the loading of the PJM-NY and NY-IMO interfaces to rise toward 3,500+ MW.

Within six seconds, the ties between PJM and NY tripped, and in the following three seconds the ties with ISO-NE opened, followed in rapid succession by the severing of the NY Total East interface. This resulted in the separation of the NYISO system into two electrical islands, and the separation of the Ontario system from western New York just west of Niagara Falls, Ontario.

NYISO Pre-Disturbance System - Progression of Disturbance outside of the NYISO

The Slow Progression of Transmission Trips in Northeastern Ohio

Through the mid-day hours, loads in the midwestern systems were running above anticipated levels and, as a result, voltages on the 345 kV systems in Indiana and Ohio were at or below minimum levels, particularly in the Akron and Cleveland areas of the FirstEnergy system.

By mid-afternoon, as conditions continued to worsen, operators in the FirstEnergy system control center did not detect and react to the changing system conditions and configuration due to the failure of the alarms processor of their energy management system, and failure to determine system conditions by alternate means.

Following the loss of the Eastlake unit #5 (13:31) and the failure of the FE EMS alarm's functionality (14:14), the tripping of three 345 kV lines supplying the Cleveland area from the south were not detected by the FE system operators:

15:05:41 Harding – Chamberlin 345 kV trips
15:32:03 Hanna – Juniper 345 kV trips
15:41:33 Star – South Canton 345 kV trips

Each of these lines tripped indicating single phase to ground faults, and in each case the cause has been determined to be contact with vegetation in the right-of-way.

The loss of these lines caused significantly increased loading on the underlying 138 kV transmission system in the Akron and Cleveland areas. Between 15:39 and 16:08 there was a rapid cascading failure of sixteen 138 kV lines and loss of about 600 MW of local load. This also resulted in the loss of the Tidd – Canton Central 345 kV circuit at 15:45:39.

This sequence caused increased loading on the Sammis – Star 345 kV circuit, causing it to load to over 120% of its normal rating. At 16:05:57 this line tripped (due to the apparent impedance in Zone 3 of the line protection). This marks the turning point in the event from a slow progression of transmission trips to a high-speed cascade of transmission line and generator trips.

Following the loss of Sammis – Star, the Cleveland load was being supplied by one 345 kV line from Erie, PA in the east, and by one 345 kV and some 138 kV circuits from the Toledo area to the west. There were no remaining 345 kV lines connecting the Cleveland load center from the south. At that point, power that was flowing from the south sought these two alternate paths.

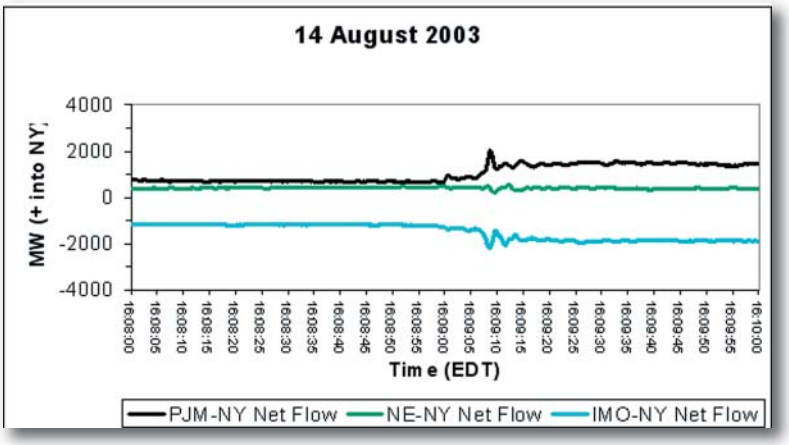
Cascade in NW Ohio and SE Michigan

The 16:05:57 trip of Sammis – Star is the first event that could be identified in the review of the NYISO telemetered data. This caused an increase in flow of approximately 100 MW on the PJM to NY ties and a 100 MW increase in flow toward Ontario; at the same point the data show an abrupt increase of 0.02 Hz in the frequency – indicating a loss of at least 700 MW load.

The power flowing into the Toledo area from southern Ohio caused the remaining two ties between FirstEnergy and AEP to trip:

16:08:59 Galion – Ohio Central – Muskingum 345 kV

Figure 2.1 Initial External Interface Flows

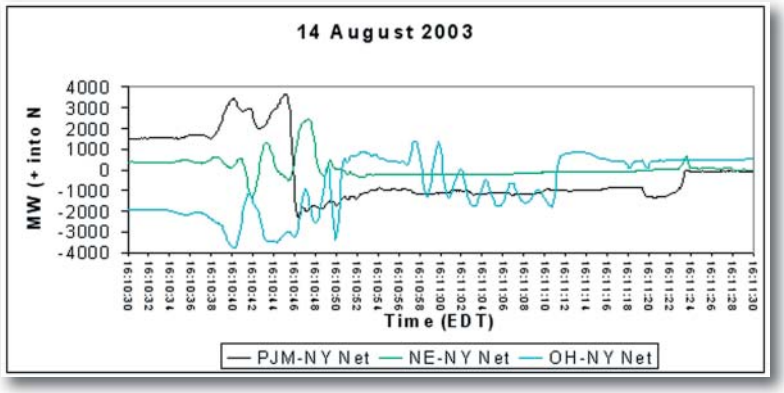


16:09:06 East Lima – Fostoria Central 345 kV

When these lines tripped, a large power swing occurred through central Michigan (2,000 MW) and through Pennsylvania, New York (700 MW) and Ontario to supply the FE system. Also during the next 30 seconds, over 900 MW of generation tripped in the Midwest systems (Michigan and Ohio).

The 700 MW swing and the additional increase in flow as the generation tripped is clearly documented in the IMO-NY interface flow. The FirstEnergy system was then connected to the Eastern Interconnection only through its ties to Detroit Edison (north from Toledo) and the Ashtabula – Erie West 345 kV circuit to Pennsylvania.

Figure 2.2 External Interface Flows During Event

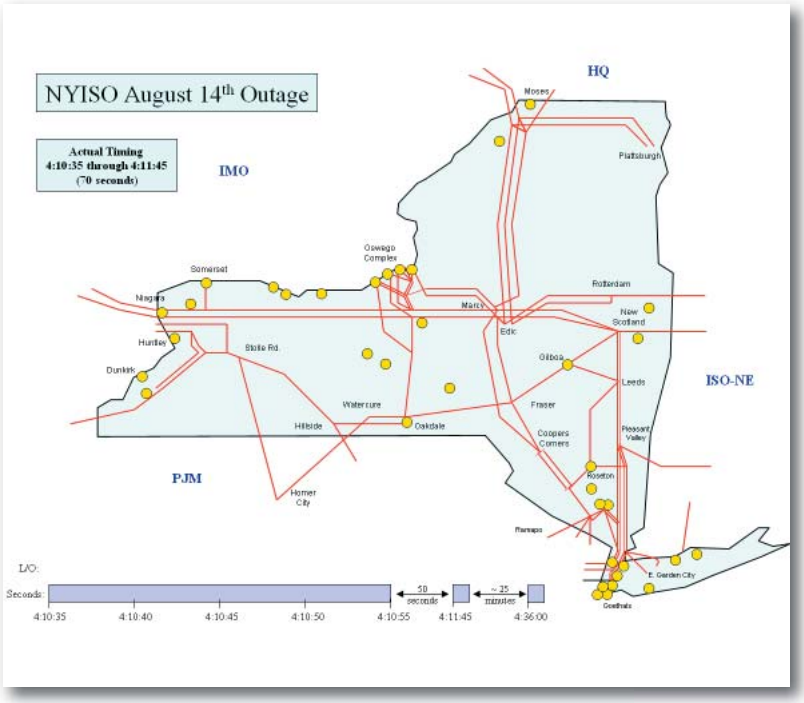


Heavy power flows on the 345 kV transmission system in central Michigan resulted in the tripping of generation and, ultimately, the tripping of these transmission lines.

16:10:36.2 Argenta – Battle Creek 345 kV
16:10:36.3 Argenta – Tompkins 345 kV
16:10:36.8 Battle Creek – Oneida 345 kV
16:10:38.2 Hampton – Pontiac 345 kV
16:10:38.2 Thetford – Jewell 345 kV

These transmission lines connect the Consumers Energy and Detroit Edison systems. Loss of these lines effectively disconnected the Detroit Edison system from the rest of Michigan. At this point, the Detroit Edison and FirstEnergy systems were connected to the rest of the eastern interconnection through Detroit's ties to Ontario.

Figure 2.3 NYISO Pre-Disturbance System



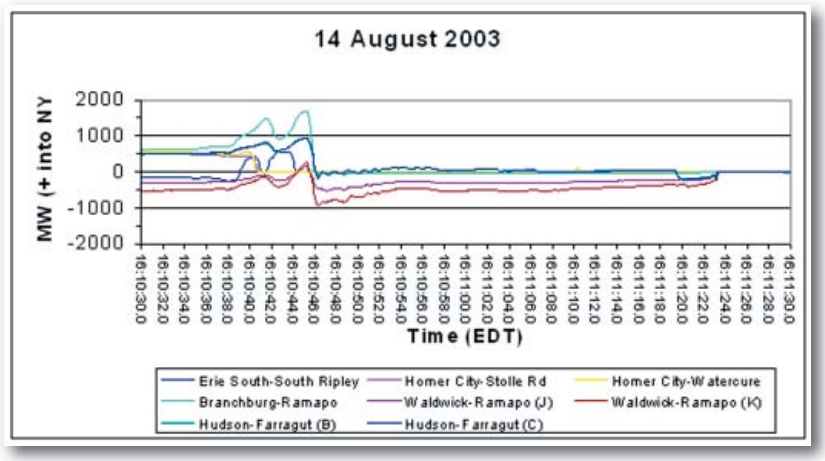
As these separations occurred in central Michigan, a very large power swing moved east and north into Pennsylvania and New York and across Ontario in an attempt to serve the loads in southeastern Michigan and northern Ohio.

16:10:36.6 Erie West – Ashtabula 345 kV trips

Altogether, these line trips effectively separated the FirstEnergy and southeastern Michigan systems from the Eastern Interconnection except for the remaining path from PJM through New York and Ontario.

Loss of PJM-NYISO Ties

Figure 2.5 PJM Ties During Event



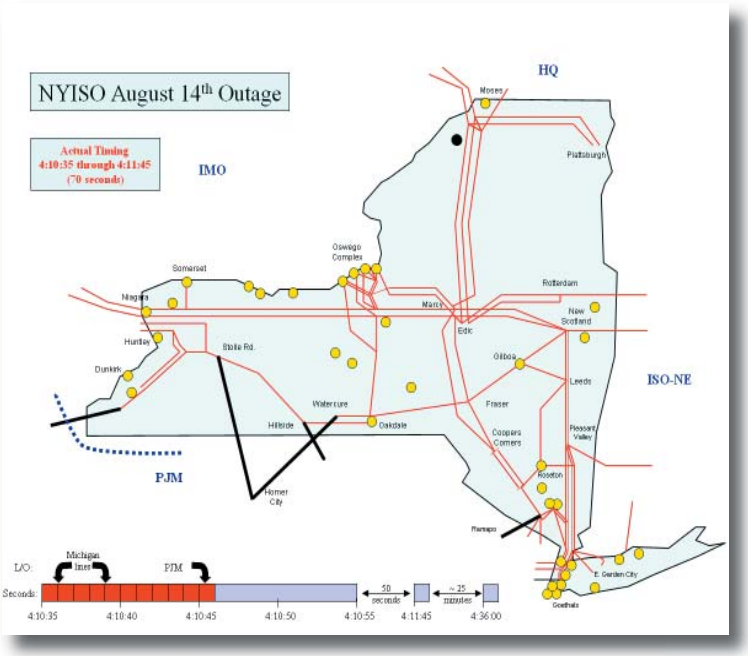
The cumulative effect of the line tripping in northern Ohio and southeastern Michigan resulted in a sudden power swing, estimated to be in excess of 3,500 MW, which entered the NYISO system from PJM and flowed through New York and westward into the Ontario system at Niagara. In the next few seconds, the following lines tripped:

16:10:39.5 Homer City – Watercure Rd 345kV
16:10:39.8 Homer City – Stolle Road 345kV
16:10:43.4 East Towanda – Hillside 230 kV
16:10:43.7 South Ripley – Dunkirk 230 kV

The Homer City 345 kV lines to New York, and South Ripley 230 kV tripped due to apparent impedance in zone 1. The East Towanda – Hillside 230 kV circuit indicated apparent impedance in zone 3 from Hillside. The next lines to trip were:

16:10:45.2 Branchburg – Ramapo 500kV
16:10:45.5 Athenia – Roseland – Cedar Grove 230kV (2 circuits)
16:10:45.8 Linden – Bayway 230kV

Figure 2.4



The separation of parallel 230 kV and numerous 138 kV lines in northern New Jersey completed the separation of PJM and the NYISO and also separated the Rockland Electric and PSE&G northern division from the main PJM system as well. This northeastern part of New Jersey remained connected to the NYISO through the Ramapo – Waldwick 345 kV, and Hudson – Farragut 345 kV circuits. On the initial separation, there appeared to be 2, 200 MW of flow into New Jersey on the above ties. Within eight seconds, the flow quickly dropped to 1,100 MW and over the next minute to approximately 450 MW. (Please see figure 2.2)

16:10:45.265 Marathon – Wawa 230kV(2 circuits)

Nearly simultaneously with the PJM-NY separation, the Ontario main system separated from Manitoba and Minnesota north of Lake Superior. This is a long (and, therefore, weak) path.

With the opening of the PJM – NY interconnections, the NPCC, Detroit Edison, and FirstEnergy systems, and northeastern New Jersey, were completely separated from the Eastern Interconnection, forming a large NPCC island.

Within this large island several smaller islands formed:

New York – New England upstate ties separate:
16:10:47
New York separates along Total East interface:
16:10:49
Ontario separates west of Niagara Falls:
16:10:50
Southwest Connecticut separates from New York:
16:11:22
Ontario – Michigan separate:
16:11:57

Separation from ISO-New England

At 16:10:46 – 16:10:47 the ties between ISO-NE and New York tripped, and an island was formed including most of the ISO-NE Area and the Canadian Maritime provinces of New Brunswick and Nova Scotia.

Upon separation from New England, the frequency in the larger island, consisting of New York, the IMO, southeastern Michigan and FirstEnergy, declined rapidly to 59.3 Hz due to the severe generation deficiency in the island (particularly in the Detroit and FirstEnergy areas), and frequency in the New England island recovered to 60.0 Hz.

Immediately prior to the separation, a power swing out of New England was experienced due to the inertial response of the generation caused by the declining frequency. Essentially, the New England generators began to increase output to "feed" power westward toward Ontario and Michigan.

Figure 2.7 System Frequency

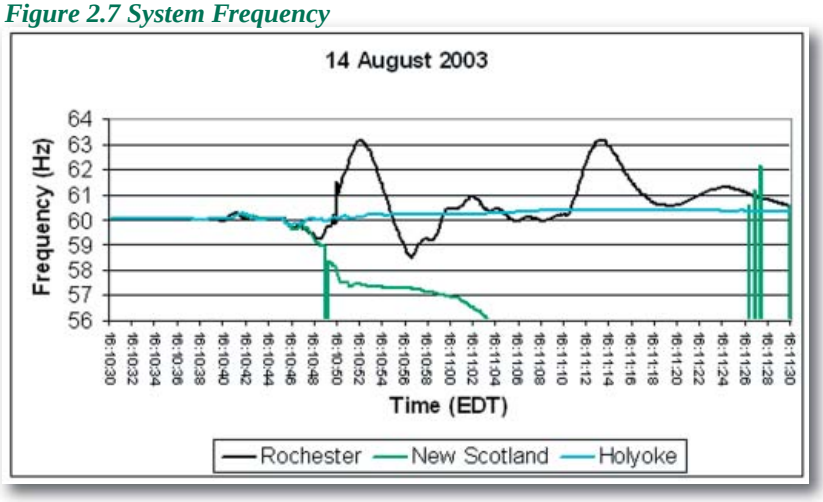
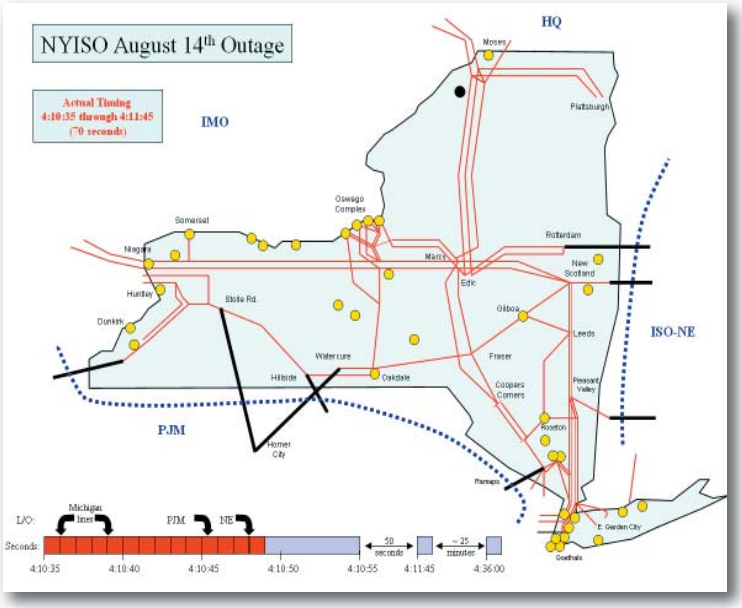


Figure 2.6

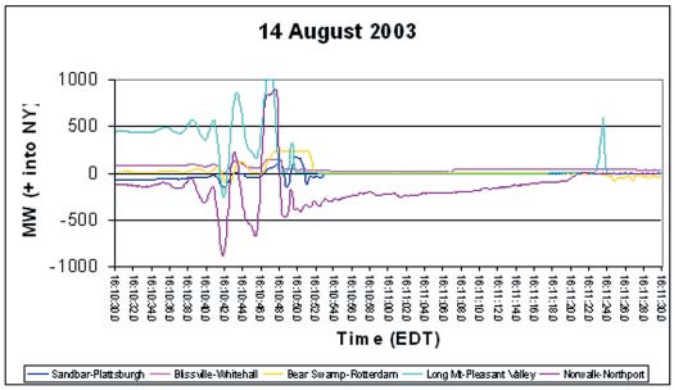


Within three seconds of the separation from PJM, the major ties between ISO-NE and the NYISO opened:

16:10:46.7 Rotterdam – Bear Swamp 230 kV
16:10:47 Alps – Berkshire – Northfield 345 kV
16:10:47.5 Long Mountain – Frost Bridge 345 kV

Prior to the disturbance, ISO-NE was exporting power to the NYISO. This, combined with the power flows toward southwestern Connecticut, caused the 345 kV Pleasant Valley path to open east of Long Mountain rather than the actual NY-NE tie.

Figure 2.8 ISO-NE Ties During Event



16:10:47.5 Whitehall – Queensbury 115kV
Spier Falls – Queensbury 115kV
16:10:48 Hoosick – Bennington 115kV

These lower voltage circuits tripped to complete the separation between the upstate portion of the eastern New York island and New England. The separation in the vicinity of Whitehall resulted in the Whitehall local area load being supplied radially from Rutland (VT) as the 115kV circuits between Spier Falls and Rotterdam also opened.

Additional 115 kV transmission and 345/115 transformers tripped to separate southwestern Connecticut from the main New England system and left it connected only to New York through the Pleasant Valley – Long Mountain 345 kV line and the Northport – Norwalk Harbor 138 kV line. Just prior to the NY/NE separation, the power flow from New England toward New York rapidly increased to over 2500 MW; then, as the northern ties and the Long Mountain – Frost Bridge line tripped, the flow reversed toward southwest Connecticut to approximately 950 MW and dropped to about 500 MW within about 10 seconds. This was further reduced to approximately 300 MW when the Long Mountain path opened at 16:11:22, and the southwestern Connecticut and the LIPA system separated from southeast New York.

16:10:54 Plattsburgh – Sandbar 115kV
16:10:55 Smithfield – Falls Village 69kV

The Plattsburgh – Sandbar line remained in service between the ISO-NE main system and the western NY island. Examination of the power flow on this line reveals significant power oscillation between the two systems during the 8-second period prior to the trip when the frequency in the western NY island rose to over 63Hz while the frequency in the NE system remained close to 60Hz. The Smithfield – Falls Village line tripped from the NE terminal; this is a very high impedance path that parallels the Pleasant Valley – Long Mountain line.

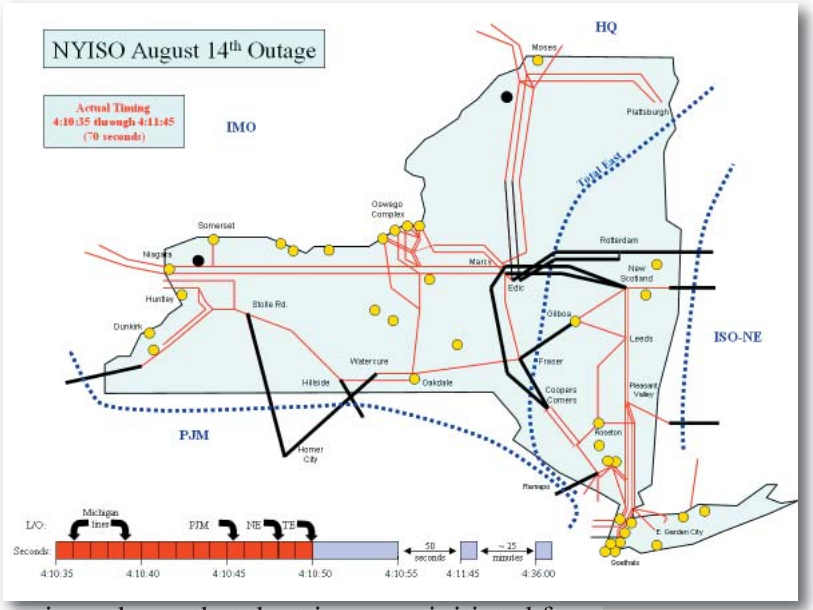
Separation of New York Total East Interface

The major transmission paths between central and eastern New York opened nearly simultaneously:

16:10:48.823 Marcy – Coopers Corners 345 kV UCC2-41
16:10:48.890 Marcy – New Scotland 345 kV #18
16:10:48.939 Edic – New Scotland 345 kV #14
16:10:48.969 Fraser – Gilboa 345 kV GF5-35
16:10:49 Fraser – Coopers Corners 345 kV FCC-33
16:10:49.6 Porter – Rotterdam 230 kV (2 circuits) #30, #31

The comparison of the frequency recordings from Rochester and New Scotland (figure 2.7) indicates that the eastern and western parts of the NY system were beginning to separate at about 16:10:47. Examination of the trip times for the 345kV circuits from the Edic/Marcy

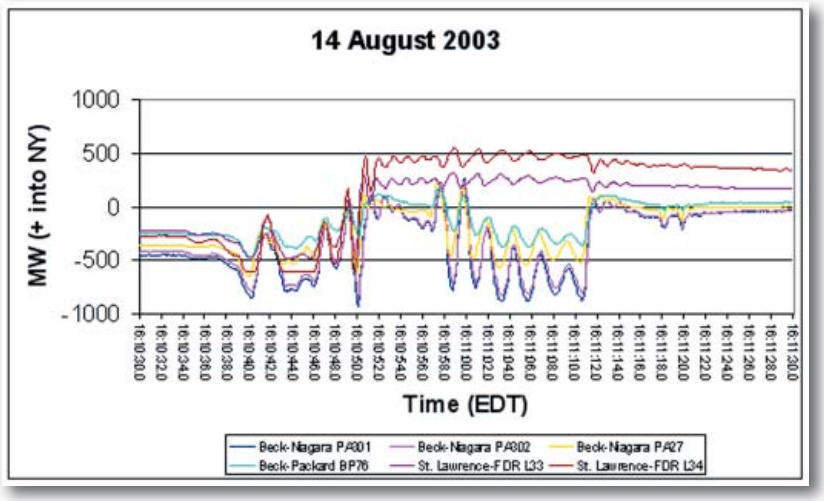
Figure 2.9



stations shows that the trips were initiated from both terminals within milliseconds, indicating that the "out of step" condition appeared (nearly literally) at the mid-point of each line.

The result was the effective separation of eastern New York from the systems to the west. The eastern New York island, including southwest Connecticut and northeast New Jersey, was severely generation deficient. The frequency in the eastern island declined rapidly through 59.0 Hz to approximately 57.5 Hz and all stages of automatic under frequency load shedding operated in the eastern island to disconnect 7,115 MW load by 16:10:54.

Figure 2.10 Central East Ties During Event



Separation of Southwest Ontario from New York

The Ontario system separated west of the Niagara Falls (Beck station) and Cornwall (St. Lawrence) areas less than one second after the Total East separation of eastern New York from the larger island to the west.

16:10:49.420
St. Lawrence – Hinchinbrooke 230 kV (3 circuits)
St. Lawrence - Albion 230 kV

16:10:49.797
Middleport – Hamilton – Beck 230 kV (5 circuits)

When the separation occurred, a new island formed including New York (west of Total East), the Ontario Beck and Saunders generation, and the Niagara Falls (Ontario) load. This island was generation rich, and the frequency rose to 63.2 Hz.

Transmission lines (3 circuits) between Middleport and Beck reclosed at 16:10:56, reconnecting the western New York island with the severely generation deficient southwest Ontario island (including Detroit Edison and what was left of FirstEnergy). The frequency declined rapidly to 58.5 Hz and the power oscillations (on the IMO-NY ties) returned with power flowing toward Ontario. The rapid frequency decline initiated both stages of under-frequency load shedding in the western New York island, and 3, 389 MW of load in western NY was disconnected by 16:11:15. The three Middleport – Beck circuits tripped and locked

out at 16:11:10.3, and the western NY island frequency again rose toward 63.0 Hz. In Figure 2.12, the large power oscillations evident prior to the initial separation west of Beck, and again during the period when the three Beck – Middleport circuits were reclosed, indicate that the systems to the west (southwest Ontario, southeastern Michigan) were losing synchronism with western NY/eastern Ontario system.

In the southwest Ontario island (including Detroit and what was left of the FirstEnergy system) frequency declined to 57 Hz and less than a minute later, at 16:11:57, the Ontario – Michigan ties opened, but too late to save the main Ontario system.

Figure 2.11

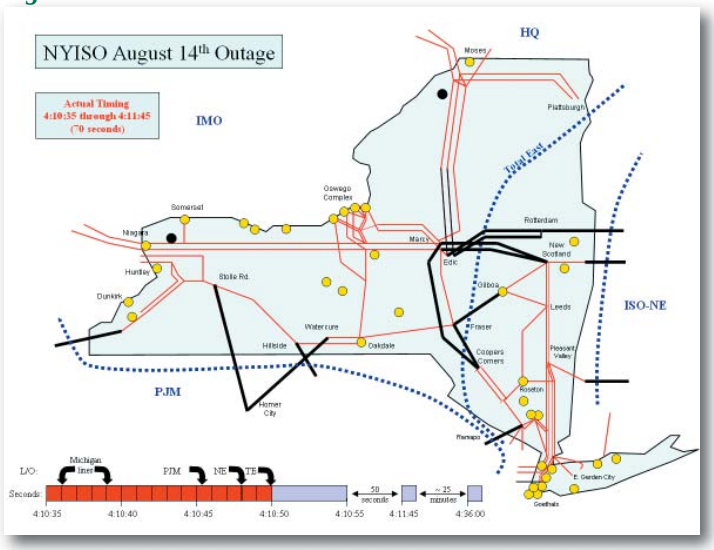
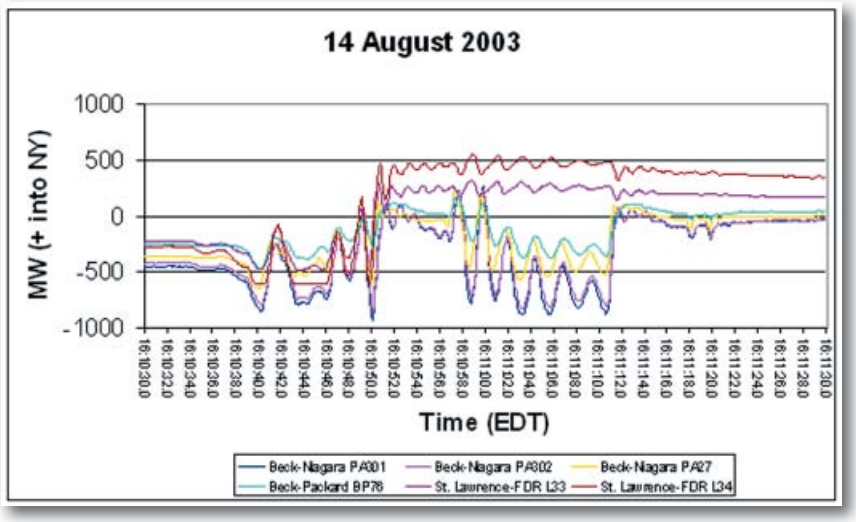


Figure 2.12 IMO Ties During Event



Collapse of Eastern New York Island

In the eastern New York island, after separating from the west, the frequency declined toward 57 Hz. Due to the low frequency and low voltages, the Indian Point units #2 and #3 both tripped on low reactor coolant flow. The reactor trips were initiated at 16:10:51 and 16:10:54, respectively. Frequency in the eastern New York was effectively in free fall. Over the next minute, many generators within this island tripped as a result of the low frequency, low voltage, or both.

The Southwestern Connecticut and LIPA systems separated from eastern NY at 16:11:22:

16:11:22
Long Mountain – Plumtree 345 kV

16:11:22.669
Sprain Brook – East Garden City 345 kV

16:11:23.503
Dunwoodie – Shore Road 345 kV

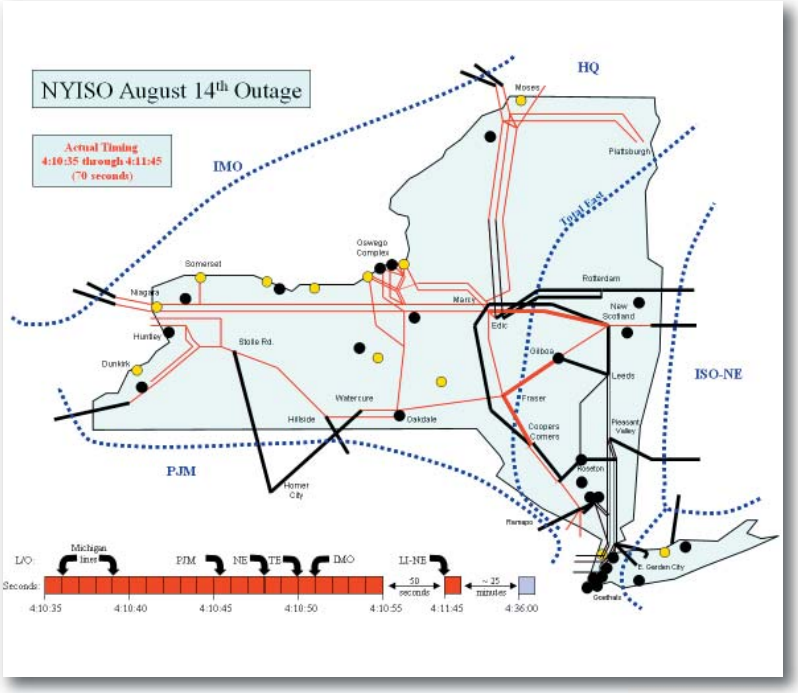
Opening of the Long Mountain – Plumtree circuit caused the remaining load in southwest Connecticut to be supplied only through the Northport – Norwalk Harbor 138 kV cable. Tripping of both the Y49 and Y50 circuits was due to Zone 1 distance impedance relays at the both terminals of Y49, and the Dunwoodie terminal of Y50, and was likely the result of the severely depressed voltage in the Sprain Brook area. With the opening of the Long

Mountain – Plumtree 345kV circuit (in southwest Connecticut) and the Y49 and Y50 circuits between Con Edison and LIPA, the southwestern Connecticut and LIPA systems were effectively separated from the rest of eastern New York and formed another island.

16:11:45 Northport – Norwalk Harbor 138 kV

For roughly the last 25 seconds prior to tripping, this line supplied about 300 MW toward Connecticut. When it tripped, southwest Connecticut was isolated, and collapsed.

Figure 2.13 IMO Ties During Event



Reclosing and Reconfiguration of the Western New York Island

Within the NYISO, transmission line reclosings, both automatic or operator initiated, occurred following the initial trips and separations. These operations moved the boundary between the islands, re-energized portions of the 345 kV system, but did not immediately restore any load that was interrupted.

At the same time some of the reclosings were occurring, there were additional line trips within the eastern area.
The most significant of these operations were:

16:11:10
Fraser – Gilboa 345 kV reclosed

16:11:23
Fraser – Coopers Corners 345 kV reclosed
Coopers Corners – Rock Tavern 345 kV (CCRT-34) tripped
Rock Tavern – Roseton 345kV tripped

16:11:23.5
Ladentown – Buchanan South 345 kV tripped

When Fraser – Coopers Corners reclosed, the Coopers Corners – Middletown – Rock Tavern and Rock Tavern – Roseton 345 kV circuits tripped; however, a complete 345 kV path was reestablished between Utica, in central New York, and Ramapo (and thereby, from Niagara to Waldwick, NJ).

16:11:29.8 New Scotland – Leeds 345 kV (2 circuits) tripped

16:11:30 Edic – New Scotland 345 kV reclosed

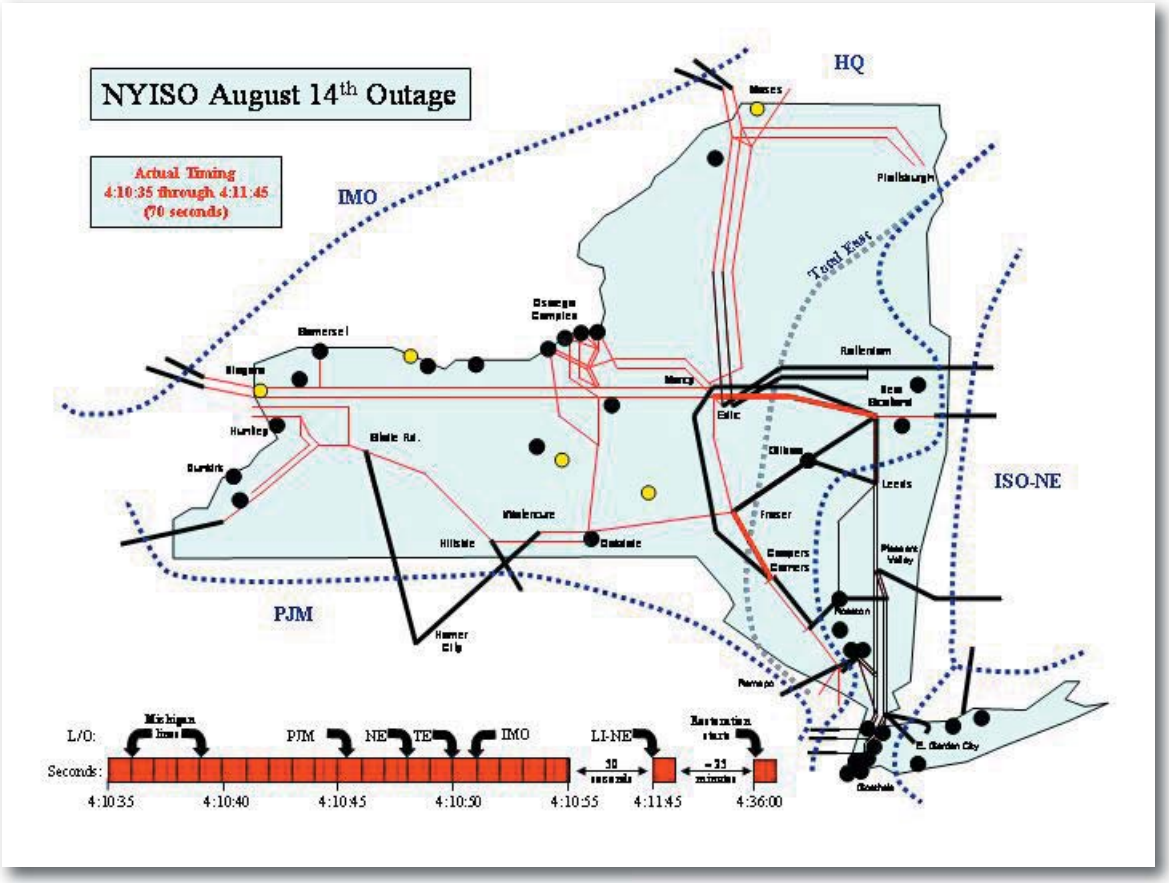
When Edic – New Scotland reclosed, the New Scotland – Leeds (2 circuits) tripped. (The reclose times are based on EMS time records, whereas the trip times are based on the New Scotland DFR.) This restored the 345 kV path from Utica to Albany, and effectively transferred the remaining load in the northern portion of the eastern island to the western New York island.

In the western island, the severe frequency oscillations resulted in the tripping of the large nuclear and combined cycle units in the Oswego area. Some of the fossil fueled generation in western New York tripped by relay protection, and some units were tripped by operator action because the units were becoming thermally unstable (boiler or fuel issues). This operator action, in several cases, enabled the quick restart of these units during the restoration process.

A major portion of the northern section of the Eastern Interconnection was blacked out. Some isolated areas of generation and load remained online for several minutes. Some of those areas in which a close generation-demand balance could be maintained remained operational; other generators ultimately tripped offline and the areas they served were blacked out.

At 16:08, just prior to the event, the NYISO was serving approximately 28,700 MW of load. Ten minutes later, the load was 5,716 MW, representing a loss of 22,984 MW. Automatic underfrequency load shedding disconnected a total of 10,648 MW statewide.

Figure 2.14 End State of August 14 Event



3. Bulk Power System Restoration

Introduction

The NYISO, working with the NYISO Restoration Working Group, reporting to the System Operators Advisory Subcommittee (SOAS), and the NPCC Inter-area Restoration Coordination Working Group reviewed the steps taken and the actions required to restore the New York State Power System following the system collapse of August 14, 2003. The material presented in this report is a result of the efforts put forth by the participants on the NYISO Restoration Working Group and by NYISO Staff. Observations made in this section of the report are directed at restoration efforts at the NYISO and have been provided as resources for other reports.

Recommendations have been identified in various sections of this report. These recommendations are a result of the review of the incident by the NYISO, Market Participants, and NPCC. As a result of this joint effort, these parties will be working together to address these recommendations as appropriate.

The NYISO entered a "Restoration State" at approximately 16:11. The NYISO Emergency Operating Manual defines a Restoration State as occurring when an area within the NYISO Control Area becomes islanded, or when customer load becomes interrupted. The Manual details the procedures the NYISO employs for the restoration of service to the New York State bulk power system. The NYISO also based its operations on the foundations set in the NPCC Inter-Control Area Power System Restoration Reference Document for inter-control area coordination.

The NYISO's restoration actions focused on the following goals:

- Stabilize the remaining NYCA transmission system.
- Extend the stabilized system to blacked-out areas to provide start-up power and customer load restoration.
- Extend the stabilized system to energized islanded areas to restore frequency control.
- Restore normal transmission system operations.

(Guidelines of the NYISO's Restoration Plan were followed.)

Following these goals, these operations have the highest priority:

- Energize the NYS Power System.
- Synchronize the NYS Power System with the interconnection.
- Restore off-site power to the nuclear power plants.

The NYISO's restoration actions followed the priorities set in the Plan and did not encounter any significant impediments. These operations are acted on in parallel with equal importance. Power restoration to the upstate New York and Long Island areas, and parts of Westchester County and New York City, began Thursday evening. The restoration to the rest of the downstate load did not begin until the backbone transmission system was re-energized, allowing major generating plants to be resynchronized to the grid in southeastern New York.

Restoration and Timeline

The NYISO entered the Restoration State at approximately 16:11 on August 14th. During the initial minutes following the disturbance, the NYISO operators' primary focus was to get an accurate assessment of the system available to begin a successful restoration.

Initial conversations included the sharing of information on the status of each TO's area and the expected restoration procedures. The TOs and the NYISO also conferred to set up the actions needed in anticipation for re-synchronization. All restoration activities, including those required for synchronization, were carried out through coordinated steps controlled by the control center system operators. Likewise, the NYISO was in constant communications with the neighboring Control Areas principally through the control center system operators.

Initial Assessment at 16:18

The NYCA transmission system was islanded with radial interconnections on the Ontario ties at Niagara and St. Lawrence and the Quebec tie into Massena. Radial load also remained on the ties out of Waldwick station into the PJM system. The outer boundary of the New York bulk power transmission system that remained in service included Niagara station in the West, St. Lawrence/Massena station to the North, New Scotland station in the Capital area, Ramapo station in the Hudson Valley, and Oakdale station in the Central LBMP zone. These locations along with associated transmission accounted for approximately 60 percent of the basic minimum power system that remained intact.

At 17:00, the existing island remained relatively stable and was able to serve about 5,700 MW of load in the western, central and eastern regions of upstate New York. Hydro generation at Beck, Niagara, Saunders and St. Lawrence, some thermal generation in western New York, and the HVdc intertie with Quebec formed the basis for restoration of both the New York and Ontario systems. In addition, the NYISO was importing slightly over 2,400 MW and serving 700 MW of load in northern New Jersey.

There were large frequency and voltage deviations during the islanded period as generation and load imbalances were encountered.

Gilboa Black Start and Interconnection with the Eastern Interconnection (16:30 –19:30)

At 16:27, after determining that Gilboa was isolated from the remaining island, the NYISO ordered Gilboa to begin its black start procedures. Unit black start procedures were completed successfully. Synchronization to the backbone was delayed due to the inability to close in on the Gilboa – Fraser 345 kV line. NYPA determined that this line could not be closed at Gilboa due to the large voltage disparity between Gilboa and Fraser. Initially this was complicated by an erratically operating switch yard synchroscope at Gilboa, until an operator was able to switch over to a backup synchroscope. System voltages were not stabilized until the Marcy-New Scotland 345kV line was restored at 19:05. Subsequently, the Gilboa-New Scotland, Fraser-Gilboa and Gilboa-Leeds 345 kV lines were all restored within the next 15 minutes.

The NYISO maintained communications with the IMO concerning the Saunders and Beck generation, which were radially connected to the NYISO system. In addition, the NYISO confirmed with PJM that the Waldwick interconnections were still in service, supplying load in Northern New Jersey, that was radial to New York.

NYISO contacted LIPA at 16:45 to inquire about system status. LIPA reported that it had com-

pletely separated and planned to bring on gas turbines to begin restoration procedures as soon as possible. It would not be until 05:12 on August 15, 2003 that the LIPA system would be synchronized with the NYCA. Until that time, LIPA restored load and generation in an islanded mode.

At 17:15 over the Hotline, the NYISO reported to the TOs the status of the bulk power system, and directed them to follow through with their local restoration plans and to coordinate anything affecting the bulk power system with the NYISO.

As the NYISO undertook efforts to maintain frequency, conditions warranted a load shed request at 18:01. Niagara Mohawk was ordered to shed 300 MW of load west of Edic for frequency control.

One of the NYISO's first objectives was to resynchronize the NYCA transmission system with the PJM 500 kV interconnection at Ramapo in order to restore normal frequency control to the New York island. The effort to achieve synchronization was complicated by the islanded NYISO operation. To allow the NYISO restoration to proceed most efficiently, the need to synchronize the NY island to the Eastern Interconnection via the PJM 500 kV interconnection was given the highest priority, to stabilize the frequency.

Synchronization to the PJM grid was initially discussed at 17:18, but an attempt to synchronize at Ramapo at 18:02 was unsuccessful due to large frequency imbalance between the islanded NYISO and Eastern Interconnection through the PJM system. For the next hour, the NYISO, NYPA, Con Edison, and Orange & Rockland coordinated the New York system load configuration and generation to make a second attempt.

The first synchronization to PJM took place at South Ripley at 18:52 when an auto synch-check relay allowed a reclosing scheme to continue a reclose attempt on the 68 and 69 lines synchronizing Erie East (PJM) – South Ripley-Dunkirk 230 kV tie at South Ripley. This was the second of two auto-reclose attempts that was locked out by the synch-check relay during the initial event, approximately 16:10. As the NYPA, Con Edison and Orange and Rockland worked to get the NYCA closer to Eastern Interconnection, the auto synch-check relay at South Ripley saw the systems close enough to complete the second reclose. The reclose was successful. With efforts focused on synchronization at Ramapo, those involved were unaware of the synchronization at South Ripley. Coordination actions continued between NYISO, NYPA, Con Edison and Orange and Rockland.

At 19:06, the NYISO directed Con Edison personnel to manually close into the PJM 500 kV grid via synchroscope operation at Ramapo station. As the re-closing steps at Ramapo continued, the technician noted that the synchroscope was at twelve o'clock on the dial, most likely indicating the previous synchronization, unknown at that time, with PJM. The re-closing at Ramapo remained in service, providing a strong 500 kV tie to the Eastern Interconnection, adding to the existing 230 kV tie.

Extending the system to blacked-out areas to provide station power and customer load restoration (19:30 – 24:00)

By 19:08, with New York resynchronized with PJM at Ramapo, the process to extend the now stabilized system into the blacked-out southern island was well underway. At 19:56, a Southeast transmission corridor from Buchanan to Eastview and from Eastview to Sprainbrook was energized to Sprainbrook station. Load was restored for voltage control.

The NYISO and the TOs continued to energize the bulk power system and pick up load throughout Thursday evening. By 21:50, the

energized transmission grid was extended along the Northeast corridor from New Scotland 345 kV into Westchester through the Leeds, Pleasant Valley, Wood Street, Millwood, and Eastview 345 kV substations. At 00:08 on August 15th, the Northeast corridor feeders and the Southeast corridor feeders into Sprainbrook were then paralleled at Con Edison's Sprainbrook substation, thereby providing two upstate New York transmission paths to the Westchester county area, with the system now tied to the Eastern Interconnection at Ramapo 500 kV station.

At 23:00, Con Edison working in parallel with the NYISO efforts extended the energized PJM grid from PJM (Hudson 230 kV) into the Con Edison system through Farragut, Gowanus, and Goethals to the East Coast Power Linden generating station. At 23:30 the East Coast Power Linden generating station black started its facility and synchronized to the energized Goethals substation bus. This created a southern system synchronized with the Eastern Interconnection. Con Edison developed a plan to parallel the northern and southern systems via the subtransmission system but this could not be accomplished due to load restoration restrictions. At 06:29 on August 15, the southern system was then paralleled to the northern system at Farragut Substation utilizing a second supply from Hudson and PAR tap moves to adjust the phase angle.

Synchronization with ISO-NE (00:00 to 04:00 August 15th)

At 00:00 on August 15th approximately 40 percent of the load had been restored to the NYISO system. The NYISO and PJM continued to restore the remainder of the tie lines between the two control areas.

Synchronization of the New England transmission system to the NYISO's transmission system was required to be sequenced after the Southeast and Northeast corridor feeders were paralleled at Con Edison's Sprainbrook substation. This sequencing was required due to the high voltage conditions observed at the New Scotland 345 kV substation with the Northeast express feeder into NYC energized but not paralleled at Sprainbrook until 00:08.

The transmission grid was extended from the New Scotland 345 kV substation into ISO-NE by transmission through Alps and Berkshire into ISO-NE's Northfield substation. NYISO and ISO-NE coordinated the synchronization of the New England transmission system to the NYCA transmission system, via synchroscope operation at Northfield. This allowed ISO-NE to return to normal frequency control.

The New England control area was reconnected to New York and thus to the Eastern Interconnection at 01:53 EDT on Friday, August 15th. The remainder of the interconnections with ISO-NE was restored during this period.

Synchronization with LIPA (04:00-05:00)

At 04:00 on August 15th, approximately 60 percent of the NYCA load had been restored. At 04:08 Con Edison energized the Sprainbrook-West 49th Street and the West 49th Street to 13th Street 345kV circuits and began adding load to control the voltage conditions.

As the NYISO was restoring transmission, generation and load to the larger portion of the NYCA, LIPA was restoring load and generation to multiple pockets in their area, isolated from the synchronized island. Four islands of several hundred megawatts each were formed. These electrical islands were then synchronized to form a contiguous system on Long Island. The ability of the generation operators to manually control their units, both steam and gas turbines, to exact megawatt output level requests allowed for steady and continuous growth of

the islanded systems. These skills were most severely tested when system operators communicated with multiple generation operators, and substation switchmen for synchronization.

At 05:12 the energized transmission grid was extended from the Con Edison system (Sprainbrook 345 kV) into Long Island (East Garden City 345 kV). Synchronization of the Long Island transmission system to the NYISO's transmission system restored normal frequency control for Long Island.

System Wide Load Shed Order During Restoration (07:30 – 23:00 August 15th)

At 07:34, the NYISO issued an order implementing the Emergency Demand Response Program/ Special Case Resources (EDRP/SCR), which would reduce load beginning at 10:00 and continue until 24:00. The NYSDEC Air Emissions waiver was in effect and would allow generators to go to maximum capability if required. This remained in effect until the end of the Major Emergency at 24:00 on August 17th.

At 08:00 approximately 64 percent of NYCA load had been restored; however, the morning load pickup was increasing faster than the generation was coming on line. At 08:59, the NYISO made a hotline call to request immediate relief from the EDRP/SCR customers. At 09:25, the NYISO informed the TOs of the potential for rolling blackouts due to the load and generation imbalance. At 09:33, the NYISO ordered the TOs to shed 300 MW of load due to the Area Control Error (ACE) dragging 630 MW. The TOs complied with the load shedding order, and by 10:02, the NYISO informed the TOs to restore half the load that was shed in response to the NYISO's direction. At 10:24, the NYISO instructed the TOs to restore the remainder of the load.

At 12:26, the Cross Sound Cable went in service, allowing an additional 100 MW of emergency energy to flow from ISO-NE to Long Island.

The NYISO and the New York TOs worked to extend the energized NYCA grid by restoring available transmission facilities as generation capacity became available and voltage and reactive conditions permitted.

By 22:30 on August 15th, all Transmission Owners notified the NYISO that 100 percent of their customers were on line; at that point, service across the NYCA was completely restored. The NYISO remained in the Major Emergency State for the remainder of the weekend to ensure that the bulk power system was stable and the NYISO was capable of supplying load, and to ensure an orderly reopening of the energy/ancillary service markets.

Observations

Mode of Operation in the NYISO

As the NYISO system operators began to assess the system, support staff for the control room began to prepare for a long night. Managers/ supervisors began to assess the staffing requirements and began establishing roles for the support. Additional dispatch staff made themselves available and continued to provide support for the next 12 hours. The primary objective was in the hands of the system operators to carry out the goals of the restoration plan. The challenge for everyone else was to provide efficient and useful support to the system operators as the restoration process unfolded.

A team was assembled to directly interface with the system operators to provide assistance. This group prepared a secondary system status board indicating line outages and restoration events. As actions were being carried out by the operators, this team was preparing and coordinating the next steps with off floor operations at the

TO Control Centers. This team, in coordination with the shift supervisor, would review and coordinate the next steps in the restoration beyond the current activities. This plan would then be communicated with the Transmission Owners to ensure coordination.

A third group of individuals was communicating with yet another level of contacts. This group maintained contact with the neighboring control areas and was available for NPCC and NERC conference calls as required.

These levels of communication had not been previously defined or drilled. This communication process was developed on the fly and provided an adequate supply of resources and information. To date, current training and drills focused on operator actions and communications, while other levels of communications outside of dispatch operations were not considered. In the future these roles will be defined in the procedure and incorporated into future drills.

Lessons learned concerning this topic include the need to improve communications with all parties and define specific roles and staffing requirements for a set period following the event. The activities outlined above fell out due to a number of reasons including a professional staff, excellent training, and regular drills that together provided the foundation to assemble a successful team. The staff understood the tasks that needed to be completed and the skill sets that each could bring to the table. In the future, a model of this mobilization should be available for drills and training discussion that would foster discussions for improved efficiencies.

Also a "command post" needs to be dedicated for events similar to this that require phone centers and map boards for non-dispatch staff to coordinate activities off the dispatch floor. During this event, phones were used where available and other coordination efforts had to occur on the dispatch floor.

Following the initial event, communications were limited to the tasks at hand. During event reviews with Transmission Operators, it was agreed that additional communication was needed to better disseminate information concerning the state of the NYCA and the neighboring control areas. Some communication did occur between the NY TO's and the neighboring control area TOs. However this process could be improved upon.

Coordinated Emergency Response Recommendations:

- Review and evaluate specific personnel roles, responsibilities, and staffing requirements at each control center for a set period following an event of this type.

- Establish a "command post" location at each control center to be dedicated for events similar to this that require phone centers and map boards for non-dispatch staff to coordinate activities off the dispatch floor.

Black Start Operation

The NYISO Restoration Plan relies on black start facilities at three locations in the state to energize the basic minimum power system. Two of these locations, the Niagara and St. Lawrence hydro generation facilities, remained in service following the event.
At 16:27, the NYISO instructed NYPA to begin black start procedures. Following consultation with the NYISO and NMPC, NYPA commenced black start procedures at Blenheim-Gilboa by stripping the north and south 345kV buses. These procedures had been thoroughly reviewed in simulated drills, at NYPA, as re-

cently as June 2003. Implementing them provided a more certain set of initial conditions from which to begin restoration of critical 345kV facilities, which had been lost along the Hudson Valley. The only complication encountered during this sequence was an inability to synch the two black started Blenheim-Gilboa units onto the Fraser-Gilboa 345kV line. This line could not be closed at Gilboa due to the large voltage disparity between Gilboa and Fraser. System voltages were further stabilized when the Marcy-New Scotland 345kV line was restored at 19:05. Subsequently, the Gilboa-New Scotland, Fraser-Gilboa, and Gilboa-Leeds 345 kV lines were all restored within the next 15 minutes.

Synchronization

PJM

One of the NYISO's first objectives was to resynchronize the NYCA transmission system with the PJM 500 kV interconnection at Ramapo, to restore normal frequency control to the Western New York Island. While the NYISO was islanded, there were two primary areas of concern:

1.) Frequency control that requires the balance of the island load and generation resources.
2.) Voltage control on the bulk power system.

Maintaining the frequency control requires the balance of the island load and generation resources. Restoration of large amounts of load without sufficient generation would cause the frequency to decay and result in the on line generation tripping off-line. For the New York island, this was compounded by the fact that additional generation from the IMO (Beck and Saunders) was connected and additional load in Northern New Jersey was being served by the island.

The second area of concern was voltage control on the bulk power system. High voltages can result from interconnecting transmission lines without loads at the end of these lines. Thus when a transmission line is energized, there needs to be some load at the end of the line to control the voltage. But for the large amounts of load to be picked up to control the voltage and quickly restore the grid, there must be generation or an interconnection to address the frequency control concern. To allow the NYISO restoration to proceed most efficiently, the need to synchronize the New York Island to the Eastern Interconnection via the PJM 500 kV interconnection was given the highest priority, to stabilize the frequency.

Synchronization of two systems -- the Western New York Island and the Eastern Interconnection (PJM's grid) — required that the two systems be operating at nearly the same frequency. Initial synchronization occurred at S. Ripley at 18:52, a sync–check relay saw the two systems close enough to close. The NYISO was able to coordinate the balance of generation and load levels at the required frequency for the sync – check relay at S. Ripley to operate and parallel the two systems. Unaware of this synchronization, the NYISO directed Con Edison personnel to manually close into the PJM 500 kV grid via synchroscope operation at Ramapo station at 19:06. Ultimately the tie at Ramapo, which was restored at 19:08, was the second tie with the Eastern Interconnection, providing a more secure interconnection with the 500 kV and 345 kV transmission systems at PJM. Following these events the frequency control in the Western New York Island returned to near normal.

ISO NE

In preparation for synchronizing with ISO-NE, efforts were made to stabilize voltages in the eastern area of New York. Following the successful reclosing at Ramapo, system frequency in the NYCA had stabilized. At that point the

effort was to strengthen the NYCA to provide a more stable voltage platform for ISO-NE to tie into. This was accomplished while restoring lines into the Con Edison area at Sprainbrook. With the path from Ramapo to Sprainbrook restored, a parallel effort was made to restore transmission to Sprainbrook from New Scotland. This step effectively stabilized voltage allowing additional load to be restored and provided a solid platform for ISO-NE to synchronize.

The restoration path was extended from New Scotland to the ISO-NE Northfield Station. The NYISO Operator, along with the ISO-NE Operators coordinated the actions required with their associated Transmission Owners. ISO-NE utilized a pumped storage hydro facility there to synchronize with the NYCA through the use of the synchroscope at Northfield. The actions were successfully completed at 01:53 on August 15th. This synchronization could be attributed to effective communications and a good understanding of system conditions in each area.

Nuclear Power

All of the nuclear units in the NYCA tripped off line during the initial event on or about 16:11. One unit continued to receive off-site power from the local Transmission Owner. As identified in the NYISO Restoration Procedure, highest priority is given to providing off-site power to nuclear power plants during system restoration activities. The Transmission Owners are the primary contact for the nuclear plants in the NYCA. During this event, the TOs insured that the requirements identified by the nuclear plants were met. As a result, nuclear plants in the NYCA were back on line between 01:05 August 17, Sunday morning, with four additional units coming on line through August 18, 2003 at 06:05. One unit remained off-line until August 22, 2003.

Manual Load Shedding Events

Throughout this event, load and generation balance was essential. The NYISO operators instructed all TOs to notify the NYISO of all load restorations and generator availability. TOs were instructed to match load with generation as it became available. Also to be considered in this balance is voltage control. In some cases, load was restored from generation, in other parts of the NYCA load was restored to control high voltages due to line restoration. This process of coordination was very successful due to the repeated training for this type of event and the excellent communications between the NYISO and the Transmission Owner operators.

Three instances of load shed actions are discussed below. Additional load shedding may have been required at other times at the local areas.

Niagara Mohawk

At 18:01 on August 14, the NYISO Operator directed Niagara Mohawk to shed 300 MW of load west of Edic for frequency control. As some load was being restored at that time in the NYCA Island generation was not yet available, frequency was declining slowly. The 300 MW of load shed by Niagara Mohawk allowed the system to reestablish an acceptable frequency at that time.

NYPA

On August 14 between 17:05 and 19:00, corrective actions were directed by NYPA ECC operators to better balance load and generation and to stabilize voltages in the St. Lawrence (North Country) area. These actions included several 100 MW step adjustments (up and down) to the import from Hydro Quebec over the MSC-

7040 765kV line; rotational load shedding of the three 60 MW Alcoa West (formerly Reynolds Aluminum) processing lines; the opening of the two Cedars 115kV lines at Dennison Rd. to alleviate approximately 100 MW of Ontario load being served from New York (this load was shed and at about one hour later was again served but via a radial 115kV feeder from the Cedars (HQ) area) and the switching of 765kV reactor banks at Massena. As a result of these actions, no additional residential or commercial customer load had to be shed in the North Country during the course of that evening.

NYISO

By 06:00 on August 15th, 56 percent of the load had been restored in the NYCA. At 7:35 the NYISO activated EDRP/SCR programs for hours 10:00 to 24:00. The NYISO also requested voluntary public curtailment of electric use and announced temporary NYSDEC waivers of air emissions limitations. The NYISO was preparing for the morning load to begin picking up. At 08:00, in a conference call, the NYISO notified Transmission Owners that load shedding might be required due to the morning load pickup. The group agreed that load shed allocation process would be modified and that the load shed allocations would be calculated based on the percentage of the current TO load to the total NYCA load at that time.

At 09:33, the NYISO requested 300 MW of load shed, distributed among the Transmission Owners. The load shed was called due to the NYISO area control error dragging in excess of 500 MW for more then 10 minutes as defined in NYISO Emergency Operations Manual. This condition was monitored throughout the morning. The load shed effectively restored the area control error to acceptable levels.

General Communications

The NYISO maintained multiple levels of communications throughout the event. Immediately following the initial disturbance, system operators contacted the TOs to determine the condition of their systems. At a second level, NYISO Manager/Supervisor staff established contacts with staff at the TOs to plan a course of action to be carried out by the system operators. On a third level, NYISO Manager/Supervisor staff setup contacts with the neighboring control areas for communicating current system status and coordinating next steps.

The internal NYISO operating procedures follow and complement NPCC Procedures for Communications during Emergencies, C-03 and NPCC Procedures During Abnormal Operating Conditions, C-20 which establish protocols among the NYISO, transmission owners, market participants, and neighboring control areas for normal and emergency conditions.

Emergency Communication Recommendations

- Investigate the establishment of a formal process for disseminating system information to the Transmission Owners during a system disturbance enhancing the current process and procedures in place at the NYISO and at the Transmission Owners.

- Investigate the establishment of a formal process for disseminating system information to the generation owners during a system disturbance enhancing the current process and procedures in place at the NYISO and with the Transmission Owners.

- Improve communications with all parties affected, including Transmission Owners and neighboring control areas. It was agreed that additional communication was needed to better disseminate information concerning the state of the control area and the control areas around the NYCA.

A list of recommendations associated with communications is included in this section.

Transmission Operator Communications

Throughout the event, the NYISO was in constant communications with the TOs through the control center system operators (dispatchers). In addition, the NYISO established secondary lines of communications with the TOs to identify and agree upon the next steps to be carried out by the system operators. Initial conversations included the sharing of information on the status of each TO's area and the expected restoration procedures. The TOs and the NYISO also conferred to set up the actions needed in anticipation for re-synchronization. All restoration activities, including those required for synchronization, were carried out through coordinated steps controlled by the control center system operators. Likewise, the NYISO was in constant communications with the neighboring Control Areas principally through the control center system operators.

NERC/NPCC Calls

At 17:23, the NYISO began regular contact with the NERC conference calls scheduled throughout the period. The NYISO reported the current status of the system and the progress of the NYCA restoration.

Also during the evening of August 14, NPCC began to schedule regular conference calls. These calls put the five control areas in contact for system updates on a regular basis. These calls provided an alternate means from the system operator contacts to share information and to request assistance as needed.

Generator Communications

The NYISO Customer Relations Department, in conjunction with the Market Monitoring Unit, established a process for collecting generator status. Beginning the evening of August 14th and continuing periodically throughout the restoration period, NYISO staff called generators to determine their physical condition and estimated time the unit would return to service. The focus was on large capacity units and downstate units. NYISO Operations Department confirmed this information with the New York TOs and used it to prepare for next steps in the restoration.

Training

Electric power system restoration in New York takes place at two levels: the restoration of the backbone basic minimum power system coordinated by the NYISO, and the local area restoration coordinated by the TOs. Successful restoration is a knowledge-based collaboration between the NYISO, the TOs, and all the major generating operators in the state. Training provides the basis for that knowledge-based collaboration.

The NYISO conducts training seminars for NYISO/TO system operators every spring and fall. This training includes topics such as voltage control, communications, System Restoration Plan, and other topics relating to system operation. Each spring the program addresses system restoration through a review of the basic principles involved, a detailed review of the NYISO backbone restoration plan, a summary review of each TO's restoration plan, and concludes with a tabletop exercise. The exercise allows the operators to step through and simulate a system restoration following a complete system shut down. Subsequent to the joint training session,

a one day restoration drill is conducted with NYISO and TO operators stepping though the restoration process in a telephone exercise from their home control centers.

The NYISO periodically conducts a Generator Operator Training Seminar (GOTS). This is a two-day overview course of both power systems and market operations. The program includes an overview of basic principles of power system restoration, a summary overview of the NYISO backbone restoration plan, and a summary review of each TO's restoration plan. There are no restoration exercises at GOTS due to the broad range of audience and the extremely localized and specific nature of any particular generator's involvement in the restoration process.

Each of the TOs maintains a restoration plan for its specific system and provides training to its own operators on those plans. Copies of the detailed TO plans are maintained at the NYISO control room for reference.

Within NPCC, NYISO participates in both the Inter-Control Area Restoration Working Group (IRCWG) and the System Operator Training Working Group *(known as CO-2)*. The IRCWG identifies points of commonality between individual control area restoration plans and develops processes promoting the coordination of the individual control area restoration efforts. CO-2 reviews system operator training relating to NPCC inter–area matters, established criteria, terminology, polices and operating instructions; prepares and presents material at dispatcher training sessions; exchanges information on internal dispatcher training methods, and evaluates new techniques and training aids as they become available. CO-2 sponsors two-day seminars for NPCC Control Area Operators every spring and fall. Participants from PJM, Michigan and MISO areas are invited to these seminars and restoration is a major topic regularly addressed in both presentation and exercise. One of the long-term objectives of the IRCWG is to conduct simultaneous, interactive exercises across the northeast.

Training Recommendations

Participant feedback from the events of August 14-15, has indicated a need to expand the scope of training relating to the TO restoration plans and the coordination of restoration efforts between all the entities involved. In order to address that need, the following proposals are recommended:

- With due consideration to security issues, TOs should develop presentation materials and exercises on their restoration plans for the instruction of both generators in their area and NYISO Operations staff. Where possible, interactive computer simulations should be employed. This material should identify the black start capability in the area, the cold load requirements to bring each generator into service and the blocks of load required to energize the transmission system.

- TOs should annually conduct restoration seminars for generators in their area so that in the event of an emergency, all parties are aware of what needs to be done, and their role in the process. As a joint effort, Generators should participate and provide information and requirements for the start up of their facilities via their black start processes.

- TO Operators should attend the NYISO System Operator Training Seminar (SOTS). This is a semi-annual four day course on both power system and market operation. It includes segments on emergency operations and restoration.

- Generator Operators should attend the NYISO's Generator Operator Training Seminar (GOTS). This is a two day overview course on both power system and market operation, it includes a segment on restoration overview, statewide and at the TO level.

- The NYISO RWG should investigate the benefits of a second NYISO Restoration Drill in the fall of each year. These drills are typically performed on shift.

- The NYISO Training Department should expand and enhance its restoration training tools by completing the following tasks:

- Develop a restoration simulation exercise modeling each individual TO restoration plan, with special attention to how that plan interacts with the NYISO cross state restoration.

- Develop a restoration tabletop exercise, which incorporates the simultaneous, coordinated implementation of TO restoration plans and the NYISO cross state restoration.

- Develop a method for TO System Operators, Generator Operators, and neighboring Control Area System operators to interactively, and remotely, participate in restoration tabletop exercises.

Cross Sound Cable

The Cross Sound Cable (CSC) was a new HVdc tie available to transfer power between Long Island and Connecticut. At the time of the event, the CSC had completed a number of test operations, but did not have a commercial license, As a result of the blackout, the U.S. Secretary of Energy declared that an emergency existed and both the NYISO and ISO-NE were directed to operate the HVdc line for purposes of reliability during the emergency. At 12:26 on August 15, 2003 the ISO-NE notified the NYISO that ISO-NE was ready to put the CSC in service at 100 MW to Long Island.

Waiver for Emission Standards

Also at 00:21 on August 15, 2003 the Commissioner of the New York State Department of Environmental Conservation issued an Order making available certain defenses against non-compliance with emission limitations or permit conditions during the emergency for generators in the NYCA. This waiver was terminated at 24:00 on August 17th.

Restoration Conclusion

Dedicated system operators, effective restoration plans and extensive prior training allowed the NYISO to restore power to the NYCA completely in less than 30 hours. Following separation from the Eastern Interconnection, New York's bulk power system performed well, and the NYISO therefore was able to follow the principles of the Restoration Plan. In accordance with the Restoration Plan, assessment and restoration of the bulk power system began immediately following the system disturbance. The NYISO focused its preliminary efforts on stabilizing frequency in the NYCA in order to synchronize the New York island to the Eastern Interconnection, and extending the remaining transmission system to start up generation and restore customer load.

The NYISO's control room dispatchers made extraordinary efforts to coordinate with Transmission Owners and Generators through the TOs in the NYCA and with control room dispatchers in neighboring control areas. Transmission system operators and generator operators worked effectively to bring transmission facilities and generating units back into service. NYISO Operations personnel remarked on the outstanding cooperation among the various control areas and Demand Response Providers and noted that this cooperation was vital to efficient system restoration.

As a result of this review by the NYISO and Market Participant working groups, including transmission owners, several areas have been identified that may warrant an effort toward modifying or enhancing the NYISO Emergency Procedures and training program. These areas have been discussed in the previous sections.

4. The Market

Prior to 16:00 on Thursday, August 14th, the New York wholesale electricity markets were operating normally. The Day-Ahead Market (DAM) for Thursday the 14th and Friday the 15th had been completed as normal at the time of the blackout. DAM operation for Saturday the 16th and Sunday the 17th continued as normal during the restoration period. The Real-Time Market was suspended immediately following the blackout event. Normal Real-Time Market operations recommended as of hour beginning 0 on Monday the 18th. The NYISO implemented tariff provisions for the settlement of the markets in emergency situations, carried out these settlements in cooperation with Market Participants, and successfully incorporated the necessary adjustments in the August bills.

Even though the NYISO did not suffer any loss of its IT infrastructure, there was no means to operate a competitive real-time market until the bulk power system was restored, and the NYISO and transmission owners evaluated the damage (if any) to the quality of the telemetry and communications required to support real-time operation. By Friday morning, substantial portions of the network had been restored and the NYISO was reconnected to the Eastern Interconnection. The NYISO notified the market that the real-time market operation was suspended beginning at 16:00 on Thursday the 14th and would not be restored until hour beginning 0 on Monday, August 18th.

The NYISO asked Market Participants to continue to bid and offer into both the Day-Ahead and Real-Time Markets, as they normally would have. Attached are the SCUC summary reports for August 14th through August 18th in Appendix C.

DAM bids and offers were needed to carry out normal DAM solutions and unit commitments for Saturday the 16th, Sunday the 17th, and Monday the 18th. Market Participants responded as requested and bidding for those three days was generally normal. A small number of generators failed to submit offers for August 16th and August 17th while load bidding was normal. There was some drop off in the amount of virtual bidding observed for the weekend but not a dramatic amount. The NYISO, therefore, carried out the Day-Ahead Market solution processes normally and valid results were produced and posted. Specifically, the normal market assumptions were as follows:

As prescribed by the NYISO tariffs, the DAM solution was therefore consistent with what the NYISO's market software would have produced if the disturbance and outage had not occurred.

While the Real-Time Market had been suspended, the NYISO also wanted normal bids and offers available to begin testing the real-time market software (even though the results would not be binding on participants) as soon as system conditions stabilized in order to verify that all parts of real-time market operation were operating normally before restarting the market, planned for midnight Sunday night. System restoration conditions were such that the NYISO Operations Department began a systematic process of turning control of the system generation over to the dispatch software on Saturday evening. Testing of the real-time scheduling, dispatch, and market software proceeded through Sunday. The Real-Time Market was successfully restarted at midnight for hour beginning 0 Monday the 18th of August, as planned.

Summary of Settlement Rules

The NYISO staff met Thursday evening, August 14th, and Friday, August 15th, to determine how best to settle the markets during the emergency period. The tariff provides guidance on specifically this outage circumstance in Attachment E – "Temporary Extraordinary Procedures for Correcting Prices Resulting From Market Design Implementation Errors and Emergency System Conditions" of the Market Services Tariff which addresses how to set prices in circumstances where either a substantial network outage or failure of IT infrastructure prevent the NYISO from calculating prices normally. Specifically, it directs the NYISO to establish prices "as closely as reasonably practicable" to what they would have been "but for" the emergency. The NYISO concluded that the best estimate of what prices would have been but for the emergency were the DAM prices that took into account bids/offers as provided by market participants and the system conditions used for the day-ahead solution process which assumed normal scheduled outages.

This approach was more fully developed to address all aspects of real-time settlements and reviewed with market participants, the staff of the New York Public Service Commission, and the FERC. The approach was universally accepted as fair and superior to other more subjective alternatives. In addition, it had the advantage of keeping whole market participants with day-ahead obligations that were unable to meet them due to network outages by settling day-ahead and real-time imbalances at the day-ahead prices. The approach avoided unnecessary financial harm to some market participants and likewise eliminated the potential for unearned windfalls for others. The details of the settlement approach were distributed to Market Participants in early September. The NYISO was able to make the temporary software modifications to the settlement software in time to incorporate the settlement for the emergency period as part of the normal settlement invoices for the month of August.

Anomalies

A final component of settling the emergency period is consideration for extraordinary expenses (not bid or recovered by the settlement process) incurred by market participants while responding to NYISO direction during the emergency period. The NYISO has provided guidelines to market participants as to the nature of expenses that may qualify for compensation and the process to follow in making claims. The NYISO is in the process of reviewing the claims it has received to determine and validate eligibility for compensation.

5. Conclusion and On-Going Work

The Northeastern U.S., including New York State, did not initiate or contribute to the Blackout of 2003. New York's electric system functioned within its design specifications, and the restoration of service following the blackout was effective and prompt.

The U.S. Canada Power System Outage Task Force (the International Task Force) on the August 14, 2003 Blackout undertook a comprehensive eight-month investigation of the events of August 14th, and issued its final report in April of 2004. The report identified the root causes of the event, which included a number of NERC reliability rule violations, and recommended 46 specific actions for industry participants and regulators to implement. Other related investigations and audits of the blackout have been conducted which have provided additional information and recommendations. The NYISO has developed a tracking system identifying a particular recommendation with an appropriate committee, task force, working group and/ or an individual who has the responsibility to ensure continued follow through on the recommendations. In Appendix A is a summary of the 46 recommendations and the current status of each. The NYISO will continue to support and participate in these recommendations and implement changes to the system as required.

In the short term, the NYISO put in place for 2004, interim communication and procedural measures to anticipate and/or mitigate similar system events.

The NYISO and its Market Participants, the NY Public Service Commission, and the NYSRC will continue to refine their analyses of the event in order to factor them into New York's system design criteria, operating procedures, and restoration plans in the future. The NYISO's collaborative governance process will ensure that the remaining analysis and studies are thorough and that the actions flowing from them are appropriate and effective.

APPENDIX A

SEQUENCE OF EVENTS

TIMELINE

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
15:05:41		DFR	MISO	Chamber-lain-Harding 345KV line tripped	High Impedence Phase C To Ground	
15:32:03		DFR	MISO	Hanna-Juni-per 345KV line sagged and tripped	Tree Contact-visual Confirmation	
15:38:47	770	DFR	MISO	Star-S. Can-ton 345KV line trips/ recloses	Phase 3 To Ground Fault. Prior To Trip There Was 1278 Mva On The Line, The Phase 2 To Ground Voltage Was At 98% And The Phase 3 To Ground Voltage Was At 94%	
15:41:33	430	DFR	AEP	Star-S. Can-ton 345KV line trips/re-closes	Phase 3 To Ground Fault Close To The Star Terminal	
15:41:35		DFR	AEP	Star-S. Can-ton 345KV line trips/re-closes/trips	Phase 3 To Ground Fault. Locks Open At Star.	
15:42:07		DFR	AEP	Star-S. Can-ton 345KV line recloses/ trips	Recloses At S. Can-ton And Trips Again. Line Already Open At Star	
15:45:39	710		MISO	Canton Central-Tidd 345KV line trips/recloses		
16:05:57	504	DFR	MISO	Sammis-Star 345KV line tripped	1310 Emergency Rating. 1495 Mw Loading	
16:08:58	535	DFR	AEP	Galion-Musk-ingum River-Ohio Central 345KV tripped	Multiphase Fault. High Loading 1320 Mva With Emergen-cy Rating Of 1234 Mva	
16:09:06	311	DFR	AEP	East Lima-Fostoria Cen-tral 345KV tripped	High Loading 2000 Mva With Emergen-cy Rating Of 1383 Mva. Auto Reclose Is Delayed By Synch. Check Relay. Firstenergy And Aep 104 Degrees Out Of Synch. Line Closed Successfully In 1min 44 Secs.	

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:09:19		DFR	NYPA	Marcy 765kV Shunt Reactor Switched I/S		
16:10:19		EMS	Indeck	Indeck-Silver Springs Generator tripped		
16:10:19		DFR	NYPA	Marcy 345kV Capacitor #2 Switched O/S		
16:10:36	200	DFR	MECS	Argenta - Battle Creek 345kV tripped		
16:10:36	300	DFR	MECS	Argenta - Tompkins 345kV tripped		
16:10:36	384	EMS	Sithe Energies Inc.	Sithe-Massena Generator tripped		
16:10:36	600	SER	NERC	Erie West - Astabula - Perry 345kV tripped	(Last Tie On East Side Of Firstenergy)	
16:10:36	800	DFR	MISO	Battle Creek - Oneida 345 kV line recloses and trips again		
16:10:37			MISO	East to West transmission system (southern circuits) opens in central Michigan		
16:10:38	200	DFR	MISO	Hampton - Pontiac 345 kV line trips		
16:10:38	200	DFR	MECS	Thetford - Jewell 345kV tripped		
16:10:39	500	SDAC	NYSEG	Homer City-Watercure 345KV 30 line tripped	Tripped At Homer City Only	21 Zone 1 And 21 G
16:10:39	500	DFR	MISO	Monroe - Bayshore 345kV tripped		
16:10:39	600	DFR	MISO	Allen Jct - Majestic - Monroe 345kV		

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:10:39	800	SDAC	NYSEG	Homer City-Stolle Road 345KV 37 line tripped		21 - Zone 1, Channel Trip - 3f
16:10:40	0	DFR	MISO	Majestic - Monroe 345kV		
16:10:41	746	EMS	MISO	Perry Unit 1 Generator tripped		
16:10:41	831	DFR	AEP	Fostoria Central-Galion 345KV tripped		
16:10:41	911	DFR	FirstEnergy	Beaver-Davis Besse 345kV tripped		
16:10:43	328	DFR	IMO	IMO-Michigan J5D tripped		
16:10:43	400	SDAC	NYSEG	Hillside-East Towanda 230KV 70 line tripped	Zone 3 At Hillside 230kv	21 - Zone 3 - 3f
16:10:43	700	SDAC	NYISO	S. Ripley-Dunkirk 230KV 69 line tripped		
16:10:43			Niagara Mohawk	American Refuel Generator tripped		
16:10:44		EMS	PJM	Athenia 220-2 230/138 KV transformer tripped		
16:10:44			Niagara Mohawk	Indeck Olean Generator tripped		
16:10:45	200	EMS	ConEd	Branchburg-Ramapo 500KV 5018 line tripped	Other Terminal At P S E & G. Dtt From Branchburg	1st Line: 50p/5018 (Fault Detector) 86tt/5018/wl (Carrier Tt Rec. Mc). 2nd Line: 50b/5018 (Faut Detector) No 2nd Line Mc.
16:10:45	200	DFR	PJM	Branchburg-Ramapo 500KV 5018 line tripped	No Targets (Assumed Zone 1 At Branchburg)	

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:10:45	500	EMS	PJM	Athenia-Roseland 230KV line tripped	Tripped At Athenia	
16:10:45	800	DFR	PJM	Bayway 220-1 230/138 KV transformer tripped		
16:10:45	800	DFR	PJM	Linden-Bayway 230KV H-2234 line tripped		
16:10:45		EMS	PJM	Athenia-Cedar Grove 230KV line tripped	Tripped At Athenia	
16:10:45		EMS	PJM	Belleville-Athenia 230KV line tripped	Tripped At Belleville	
16:10:45		EMS	PJM	Roseland-Cedar Grove 230KV line tripped		
16:10:46	700	SDAC	ISO-NE	Rotterdam-Bear Swamp 230KV E205 line tripped		
16:10:46		EMS	Niagara Mohawk	Whitehall - Mohican 115kV trip/reclose/trip Whitehall - Queensbury 115kV trip/reclose	Whitehall Local Momentarily Isolated On Vt	
16:10:47	500	DDR	ISO-NE	Long Mt.-Frost Bridge 345KV 352 line tripped		
16:10:47	500	SDAC	NYISO	Whitehall - Queensbury 115kV tripped Spier Falls - Queensbury #17&5 115kV tripped Spier Falls - Rotterdam #1&2 115kV tripped Spier Falls - Mohican #4 115kV tripped	Whitehall 115kv Isolated On Vt Spier Falls/queensbury 115kv Islanded	

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:10:47		DFR	ISO-NE	Alps-Berkshire-Northfield 345KV 393/312 line tripped	Same Time As Nm	
16:10:47		BEN	NYISO	Apparent separation between Niagara/Rochester and New Scotland/Sprain Brook		
16:10:47		EMS	Sithe Energies Inc.	Sithe-Ogdensburg Generator tripped		Trips Due To 60v (Voltage Imbalance) Relay Action.
16:10:48	823	SER	NYPA	Marcy-Coopers Corners 345KV UCC2-41 line tripped	Opened At Marcy	21-1s Distance Relay Operation
16:10:48	890	DFR	Niagara Mohawk	Marcy-N. Scotland 345KV UNS-18 line tripped		Asea Razfe Zone 1 Phase
16:10:48	890	SER	NYPA	Marcy-N. Scotland 345KV UNS-18 line tripped	Opened At Marcy	21-1s Distance Relay Operation
16:10:48	910	EMS	ConEd	Underfrequency Load Shed	1111 Mw	
16:10:48	939	DFR	Niagara Mohawk	Edic-New Scotland 345KV 14 line tripped	Line Trip At New Scotland	Cey- Zone 1 Jbcg53 - Dg Inst Cey - Zone 2
16:10:48	940	DFR	Niagara Mohawk	Edic-New Scotland 345KV 14 line tripped	Line Trip At Edic	Cey- Zone 1 Jbcg53 - Dg Inst Cey - Zone 2.
16:10:48	969	DFR	NYPA	Fraser-Gilboa 345KV GF5-35 line tripped	Opened At Gilboa.	21-1p Zone 1 Dist. Relay
16:10:49		EMS	ISO-NE	Blissville 115/46 KV Bank tripped		
16:10:48		EMS	ISO-NE	Hoosick-Bennington 115KV 6 line tripped		

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:10:48			NYSEG	LEA Lockport units #1-#3 Generation tripped		
16:10:48		BEN	NYISO	Niagara/ Rochester Frequency at 59.20Hz		
16:10:48		EMS	LIPA	Underfre-quency Load Shed	25.6 Mw	
16:10:48		EMS	NYPA	Underfre-quency Load Shed	59 Mw	
16:10:49	420		IMO	St. Lawrence-Albion 230KV L24A line tripped	St. Lawrence Gen-eration Radial To Ny Thru L33 And L34 Par	
16:10:49	420		IMO	St. Lawrence-Hinchin-brooke 230KV L20H, L21H, L22H lines tripped	St. Lawrence Gen-eration Radial To Ny Thru L33 And L34 Par	
16:10:49	600	SDAC	Niagara Mohawk	Porter-Rotter-dam 230KV 30 line tripped	Line Trip At Rotter-dam. Sdac Confirm	Gcx Zone 1- 3-phase
16:10:49	600	SDAC	Niagara Mohawk	Porter-Rotter-dam 230KV 31 line tripped	Line Trip At Rotter-dam. Sdac Confirm	Gcy 21 - Zone 1
16:10:49	650	EMS	ConEd	Underfre-quency Load Shed	1319 Mw	
16:10:49	727	DFR	Niagara Mohawk	Edic-New Scotland 345KV 14 line closed	Line Reclosed At New Scotland Only (I.e. Line End Open)	
16:10:49	797		IMO	Beck QFW 230KV cir-cuits tripped	Beck Generation Radial To Ny	
16:10:49		EMS	Niagara Mohawk	Alps-Berk-shire 345KV 393 line tripped	Same Time As Iso-ne	No Targets
16:10:49		SER	NYPA	Brentwood GT Generator tripped		Turbine Flame Out From Loss Of Station Service
16:10:49			Niagara Mohawk	Fort Orange Generator tripped		

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:10:49		EMS	NYSEG	Fraser-Coopers Corners 345KV 33 line tripped	Opened At Coopers Corners	21 - Zone 2 Channel Trip 3phase
16:10:49		EMS	NYSEG	Fraser-Coopers Corners 345KV 33 line tripped	Opened At Fraser	21 - Zone 1 Phase
16:10:49		EMS	NYSEG	Fraser-Gilboa 345KV GF5-35 line tripped	Opened At Fraser	No Targets
16:10:49			Niagara Mohawk	Fueura/JMC Generator tripped		
16:10:49		EMS	ConEd	Harlem River GT #1 Generator tripped	Nypa Unit	
16:10:49		EMS	ConEd	Hellgate GT #2 Generator tripped	Nypa Unit	
16:10:49		EMS	NRG	Huntley 65 Generator tripped		None
16:10:49		EMS	Central Hudson	Underfrequency Load Shed	237.32 Mw	
16:10:49		EMS	ConEd	Underfrequency Load Shed	11.3 Mw	
16:10:49		EMS	LIPA	Underfrequency Load Shed	64.3 Mw	
16:10:49		EMS	O&R	Underfrequency Load Shed	345 Mw	
16:10:50	90	DFR	IMO	St. Lawrence-Albion 230KV L24A line unsuccessful reclose		
16:10:50	510	EMS	ConEd	Underfrequency Load Shed	752 Mw	
16:10:50	890	EMS	ConEd	Underfrequency Load Shed	1446 Mw	
16:10:50		EMS	ConEd	Astoria GT Generator tripped	Nrg Unit	

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:10:50		EMS	KeySpan Generation	Greenport Generator tripped		
16:10:50		SER	NYPA	Harlem River GT #1 Generator tripped		Turbine Flame Out From Loss Of Station Service
16:10:50			Niagara Mohawk	Sithe-Sterling Generator tripped		
16:10:50		EMS	Central Hudson	Underfrequency Load Shed	26.05 Mw	
16:10:50		EMS	ConEd	Underfrequency Load Shed	1206 Mw	
16:10:50		EMS	LIPA	Underfrequency Load Shed	443.4 Mw	
16:10:51			Niagara Mohawk	Green Island #2 Generator tripped		
16:10:51		EMS	NRG	Huntley 66 Generator tripped		None
16:10:51			Niagara Mohawk	Indeck Corthinth GT and ST Generators tripped		
16:10:51		EMS	Entergy	Indian Point 2 Reactor trip		22rcp Reactor Coolant Pump Low Flow
16:10:51			Niagara Mohawk	LGE Rensselaer GT and ST Generators tripped		
16:10:51			NYSEG	Saranac units #1, #2, #3 Generation tripped	Aka Falc. Sea.	
16:10:51			Niagara Mohawk	School Street #5 Generator tripped		
16:10:51			Niagara Mohawk	Spier Falls #8 Generator tripped		
16:10:51		EMS	ConEd	Underfrequency Load Shed	199.9 Mw	
16:10:51		EMS	LIPA	Underfrequency Load Shed	162.4 Mw	

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:10:51		EMS	NYSEG	Underfrequency Load Shed	414.6 Mw	
16:10:51		EMS	RGE	Underfrequency Load Shed	7.2 Mw	
16:10:52		EMS	Reliant Energy	Central misc. hydros Generators tripped		
16:10:52			Niagara Mohawk	Fenner Wind Farm Generation tripped		
16:10:52			Niagara Mohawk	Fort Drum Generator tripped		
16:10:52			Niagara Mohawk	Indeck Oswego Generator tripped		
16:10:52			Niagara Mohawk	Kamine Carthage ST Generator tripped		
16:10:52		EMS	Reliant Energy	Mohawk Valley misc. hydros Generators tripped		
16:10:52			NYPA	Moses-Adirondack 230KV MA-2 line tripped	Opened At Moses	Pri Relaying - Abc
16:10:52		BEN	NYISO	Niagara/ Rochester Frequency at 63.27Hz		
16:10:52		EMS	NYSEG	Oakdale 345 kV capacitor bank C1 tripped		59 (Over Voltage)
16:10:52			Niagara Mohawk	Project Orange 1 and 2 Generators tripped		
16:10:52		EMS	ConEd	Underfrequency Load Shed	84.6 Mw	
16:10:52		EMS	LIPA	Underfrequency Load Shed	94.5 Mw	

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:10:53			Niagara Mohawk	Burrows Paper Lyons-dale Generator tripped		
16:10:53		EMS	Reliant Energy	Capital misc. hydros Generators tripped		
16:10:53			Niagara Mohawk	Franklin Falls Generator tripped		
16:10:53			Niagara Mohawk	Fulton Generators tripped		
16:10:53			Niagara Mohawk	Johnsonville Hydro 1 and 2 Generators tripped		
16:10:53			Niagara Mohawk	Kamine Beaver ST Generator tripped		
16:10:53		EMS	NYSEG	Mill C Units #2 & 3 (NYSEG)		
16:10:53		EMS	RGE	Russell Unit #4 (RG&E)		Turbine Stop Valve Closed
16:10:53			Niagara Mohawk	School Street 3 and Generators tripped		
16:10:53			Niagara Mohawk	Sewalls Hydro Generator tripped		
16:10:53			Niagara Mohawk	Soft Maple Hydro Generator tripped		
16:10:53		EMS	Central Hudson	Underfrequency Load Shed	11 Mw	
16:10:53		EMS	ConEd	Underfrequency Load Shed	7 Mw	
16:10:53		EMS	LIPA	Underfrequency Load Shed	5.6 Mw	
16:10:53			Niagara Mohawk	Vestas Wind Generation tripped		
16:10:54		EMS	NYSEG	Cadyville Units #2 & 3 (NYSEG)		

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:10:54		EMS	HQTE	Cedars -Dennison 115kV lines CD11, CD12 tripped		
16:10:54			Niagara Mohawk	East Syrase ST Generator tripped		
16:10:54		SER	NYPA	Hellgate GT #2 Generator tripped		Turbine Flame Out From Loss Of Station Service
16:10:54			Niagara Mohawk	High Dam Hydro Generator tripped		
16:10:54		EMS	NYSEG	High Falls Units #1 & 2 (NYSEG)		
16:10:54		EMS	Entergy	Indian Point 3 Reactor trip		22rcp Reactor Coolant Pump Low Flow
16:10:54			Niagara Mohawk	Jarvis Hydro Generator tripped		
16:10:54		EMS	NYSEG	Mechanicville Hydro Units #1 & 2 (NYSEG)		
16:10:54		EMS	Reliant Energy	North misc. hydros Generators tripped		
16:10:54			Niagara Mohawk	OEF Ogensburg GT 1 Generator tripped		
16:10:54		SDAC	ISO-NE	Plattsburgh-Grand Isle 115KV PV20 line tripped	Sdac Confirm 16:10:53.3	
16:10:54			Niagara Mohawk	Sithe Lakeside GT 3 and 4 Generators tripped		
16:10:54		EMS	Mirant	Swinging Bridge 2 Generator tripped		Loss Of Ss

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:10:54		EMS	LIPA	Underfre-quency Load Shed	34.7 Mw	
16:10:54		EMS	RGE	Underfre-quency Load Shed	12.4 Mw	
16:10:55			Niagara Mohawk	Adir Hydro South Glens Falls Genera-tors tripped		
16:10:55		EMS	NYSEG	Coopers Corners 345 kV capacitor bank C1A tripped		59 (Over Volt-age)
16:10:55			Niagara Mohawk	Green Island #3 Generator tripped		
16:10:55			Niagara Mohawk	Lighthouse Hll 2 Genera-tor tripped		
16:10:55			Niagara Mohawk	Onon. Resource Generator tripped		
16:10:55			Niagara Mohawk	School Street 2 Generator tripped		
16:10:55		EMS	ISO-NE	Smithfield-Falls Village 69KV 690 line tripped		
16:10:55		EMS	NYSEG	Underfre-quency Load Shed	316.6 Mw	
16:10:56	184	DFR	IMO	Beck-Burling-ton-Middle-port 230KV Q25BM reclose		
16:10:56	379	DFR	IMO	Beck-Burling-ton-Middle-port 230KV Q23BM reclose		
16:10:56			Niagara Mohawk	Indeck Yer-kes Genera-tor tripped		
16:10:56		EMS	Reliant Energy	Mohawk Valley misc. hydros Generators tripped		

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:10:56		BEN	NYISO	Niagara/ Rochester Frequency at 58.49Hz		
16:10:56			Calpine Energy Service	Nissequogue Cogen tripped	Aka Stoney Brook	
16:10:56		EMS	NYPA	Underfre-quency Load Shed	150 Mw	
16:10:57	835	DFR	IMO	Beach-Middleport 230KV Q29HM reclose		
16:10:57	835	DFR	IMO	Beck 230KV Q24HM and Q30M unsuccessful reclose		
16:10:57		EMS	NYSEG	Coopers Corners 345 kV capacitor bank C1B tripped		59 (Over Volt-age)
16:10:57			Niagara Mohawk	Moshier Hydro 2 Gen-erator tripped		
16:10:57			Niagara Mohawk	Norwood Hy-dro Genera-tors tripped		
16:10:57		EMS	RGE	Station 80 Breakers 3502, 3402, 3T8082 trip, 345kv bus 1 dead	Transformer #1 Dif-ferential Relay 87t - Misoperation	
16:10:57		EMS	ConEd	Underfre-quency Load Shed	8.3 Mw	
16:10:57		EMS	RGE	Underfre-quency Load Shed	89.9 Mw	
16:10:58		SER	NYPA	Flynn Gen-erator tripped		High Exhaust Temp.
16:10:58		EMS	NYSEG	Fraser-Coo-pers Corners 345KV 33 line autore-closed	Closed At Fraser. Line End Open At Coopers Corners	

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:10:58		EMS	NYSEG	Indeck-Morton Salt units #1-#2 Generation tripped		
16:10:58		EMS	ConEd	Underfrequency Load Shed	106.2 Mw	
16:10:59		EMS	NYSEG	Kents Falls Unit #1 (NYSEG)		
16:10:59		EMS	ConEd	Underfrequency Load Shed	1210 Mw	
16:10:59		EMS	RGE	Underfrequency Load Shed	20.1 Mw	
16:11:00	948	DFR	Niagara Mohawk	Marcy-N. Scotland 345KV UNS-18 line closed		
16:11:00		EMS	NRG	Arthur Kill 2 Generator tripped		None
16:11:00		EMS	NRG	Arthur Kill 3 Generator tripped		None
16:11:00		EMS	Reliant Energy	Capital misc. hydros Generators tripped		
16:11:00		EMS	NYSEG	Fraser-Gilboa 345KV GF5-35 line reclosed	Reclosed At Fraser. Line End Open At Gilboa	
16:11:00			Reliant Energy	Gowanus 1-4 GT Generators tripped		
16:11:00		EMS	Mirant	Grahamsville Generator tripped		
16:11:00		EMS	NRG	Ilion Generator tripped		None
16:11:00		EMS	MISO	Midway-Lemoyne-Foster 138 (?) Kv line tripped		
16:11:00			Reliant Energy	Narrows GT Generators tripped		

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:11:00		EMS	Onondaga	Onondaga Cogen Unit #1 Generator tripped		
16:11:00		EMS	Onondaga	Onondaga Cogen Unit #2 Generator tripped		
16:11:00		EMS	Onondaga	Onondaga Cogen Unit #3 Generator tripped		
16:11:00		EMS	KeySpan Generation	Port Jefferson GTs 2 and 3 Generators tripped		
16:11:00			Niagara Mohawk	Sithe Lakeside GT 1 and 2 Generators tripped		
16:11:00		EMS	ConEd	Underfrequency Load Shed	18.6 Mw	
16:11:00		EMS	RGE	Underfrequency Load Shed	411.5 Mw	
16:11:01		EMS	NRG	Astoria GT #10-13 Generators tripped		Phase A And C
16:11:01		EMS	KeySpan Generation	East Hampton Diesels 2 3 4 Generators tripped		
16:11:01		EMS	RGE	Underfrequency Load Shed	64.6 Mw	
16:11:02		EMS	ConEd	Waterside 6 Generator tripped	"The Relay Targets & Overall Unit Protection Indicate That A Voltage Unbalance May Have Cause The Svt To Operate Tripping The Generator Breakers, Boiler, Turbine, Etc…"	Waterside59/ t6 Svt Relay (Time Element)86-3/t6 Lor59/81 Mvh Volts/hz Relay86-2/g6 Lor60/g6 Cfvb Voltage Balance Relay

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:11:03		EMS	Niagara Mohawk	Porter-Rotterdam 230KV 30 line closed	Line Close At Porter. Line End Open At Rotterdam	
16:11:03		EMS	Niagara Mohawk	Porter-Rotterdam 230KV 31 line closed	Line Close At Rotterdam. Line End Open At Porter.	
16:11:03		EMS	Niagara Mohawk	Rotterdam-Bear Swamp 230KV E205 line closed	Line Close At Rotterdam.	
16:11:04		EMS	Entergy	Fitzpatrick Reactor trip		Turbine Control Valve Low Hydraulic Oil Pressure
16:11:04		SER	NYPA	Gowanus #5 GT tripped		Turbine Flame Out From Loss Of Station Service
16:11:04		SER	NYPA	Gowanus #6 GT tripped		Turbine Flame Out From Loss Of Station Service
16:11:04		SER	NYPA	Hellgate GT #1 Generator tripped		Turbine Flame Out From Loss Of Station Service
16:11:04		EMS	NYPA	JAF MOD 10031 Generator tripped	Fitzpatrick Entergy Unit	
16:11:04		SER	NYPA	Kent Ave. GT tripped		Turbine Flame Out From Loss Of Station Service
16:11:04		EMS	ConEd	KIAC Cogen tripped	Calpine Units	
16:11:04		SER	NYPA	Pouch GT tripped		Turbine Flame Out From Loss Of Station Service
16:11:04		EMS	KeySpan Generation	Shoreham 1 Generator tripped		
16:11:04		SER	NYPA	Vernon GT #2 and #3 Generators tripped		Turbine Flame Out From Loss Of Station Service
16:11:05	695	EMS	Sithe Energies Inc.	Sithe-Sterling Generator tripped		115kv O/u Voltage Trip1 (97.71 Kv)
16:11:06		EMS	KeySpan Generation	Ravenswood 1 Generator tripped	Using Ks Time/confirmed Approx By Nyiso Ems	

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:11:06		EMS	KeySpan Generation	South Hampton GT Generator tripped		
16:11:07		EMS	RGE	Hydro Sta. #2 (RG&E)		Loss Of Excitation Trip
16:11:07		EMS	RGE	Hydro Sta. #4 (RG&E)		Loss Of Excitation Trip
16:11:07		EMS	RGE	Underfrequency Load Shed	10.4 Mw	
16:11:08	958	EMS	HQ	Beauharnois A6 Generator tripped		Ro71h Low Level Of Oil In Speed Regulation System
16:11:09	286	DFR	Entergy	Indian Point 2 Generator tripped	Time Matched With Coned. Target Info From Coned.	Buchanan1st Line: 2385x 86-1a/w95 86-1b/w95 Sv-94-1w-952nd Line: 2385x 86-2a/w95 86-2b/w95 Haamc-ip2indian Point 2 (Entergy)6.9kv Bus Uv
16:11:09		DFR	NYPA	Gilboa 3 Generator tripped		By Operator Action
16:11:09			RGE	Ginna Reactor tripped		
16:11:09			Niagara Mohawk	NYSE Saranac Energy Generators tripped		
16:11:10	94	EMS	HQ	Beauharnois A5 Generator tripped		Ro71h Low Level Of Oil In Speed Regulation System
16:11:10	300	DFR	IMO	Beck 230KV Q23BM trip	Opens At Beck	
16:11:10	444	DFR	IMO	Beck 230KV Q29HM trip	Opens At Beck Middleport And Beach	
16:11:10	515	DFR	IMO	Beck 230KV Q25BM trip	Opens At Beck Middleport And Burlington	
16:11:10		EMS	KeySpan Generation	Barrett 1 Generator tripped		Lors 86at, 86g, No Relay Targets

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:11:10		EMS	NYSEG	Fraser-Gilboa 345KV GF5-35 line autoreclosed	Fraser Breaker B1/3562 Autoreclosed Fraser -- Gilboa #35 Line Fraser Bus Restored	
16:11:10		EMS	NYSEG	Homer City -- Watercure 345kV #30 autoreclosed at Homer City	Sdac Confrim	
16:11:10		EMS	NYSEG	Homer City -- Watercure 345kV #30 tripped at Watercure	Sdac Confirm	21 - Zone 1, 2 & 3 - 3f
16:11:12		DFR	NYPA	Gilboa 1 Generator tripped		By Operator Action
16:11:12		EMS	KeySpan Generation	Glenwood GT 3 Generator tripped	Nyiso Ems Time	
16:11:12		EMS	LIPA	Newbridge-Freeport 138KV 461 line tripped		Abc Z1
16:11:12		EMS	ConEd	Pouch GT tripped	Nypa Unit	
16:11:13	75	EMS	HQ	Beauharnois A13 Generator tripped		Ro71h Low Level Of Oil In Speed Regulation System
16:11:13		EMS	MISO	Avon Unit 9 Generator tripped		
16:11:13		EMS	MISO	Beaver-Davis Besse 345kV tripped		
16:11:13		EMS	O&R	Lederle Generation tripped		
16:11:13		BEN	NYISO	Niagara/ Rochester Frequency at 63.10Hz		
16:11:13		EMS	ConEd	Vernon GT #2 and #3 Generators tripped	Nypa Unit	
16:11:14	89	EMS	HQ	Beauharnois A13 Generator tripped		Ro63 Low Air Pressure In Speed Regulation System

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:11:14	202	DFR	Central Hudson	East Fishkill 345/115KV xfmr tripped		59/81t1-a2/stv (Overexcita-tion)
16:11:14	620	DFR	Dynegy	Roseton #2 Generator tripped	Relay Operation	
16:11:14		EMS	PJM	Homer City - Wayne 345kV line HCW tripped		
16:11:14			El Paso Merchant Energy	Linden Co-gen GT 100, 200 tripped		
16:11:14			El Paso Merchant Energy	Linden Cogen GT 300, 400, 500 tripped		
16:11:14			El Paso Merchant Energy	Linden Cogen ST 100, 200, 300 tripped		
16:11:15			El Paso Merchant Energy	Rensse-laer Cogen tripped		
16:11:15		EMS	RGE	Underfre-quency Load Shed	17.6 Mw	
16:11:16		EMS	O&R	Hillburn-Ra-mapo 138KV 52 line tripped	Ramapo – Open, Close	Hillburn – 21-p Zone 1 (Dlp)ramapo – 21p, B/u Dfp Relay
16:11:17	510	DFR	Dynegy	Roseton #1 Generator tripped	Relay Operation	
16:11:17	627	DFR	IMO	Beck 230KV Q25BM unsuccessful reclose		
16:11:17	740	EMS	Sithe Energies Inc.	Sithe-Batavia Generator tripped		
16:11:18		EMS	AES Corp.	Greenidge unit #4 tripped		
16:11:19	244	DFR	IMO	Beck 230KV Q29HM unsuccessful reclose		
16:11:19	410	DFR	Dynegy	Roseton #1 Generator tripped	Breakers Opened	

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:11:19		EMS	LIPA	Underfrequency Load Shed	49.2 Mw	
16:11:19		EMS	ConEd	Waterside 8 Generator tripped	Increased Steam Flow With Resultant Drop In Drum Pressure With A Subsequent Rising Drum Level To Trip Point.	Waterside40/ gen 8 Klf-1 Loss Of Field Relay59/gen 8 Iav Neutral Over Voltage86/g8 Generator 8 Lor
16:11:21		EMS	O&R	Lovett-W. Haverstraw 138KV L53 line tripped		West Haverstraw – 21p Zone 1 (Dlp)lovett – 21p Zone 1 & Pott (Dlp)
16:11:21		EMS	O&R	Lovett-W. Haverstraw 138KV L54 line tripped	West Haverstraw – Open, Close, Open	West Haverstraw – 21p Zone 1 (Dlp)lovett – 21p Zone 1 & Pott (Dlp)
16:11:22	669		ConEd	East Garden City-Sprainbrook 345KV Y49 line tripped	Resolved Time With Lipa	Uniflex Relay Zone 1 @ E Garden City.
16:11:22	669	LIPA IRIG	LIPA	East Garden City-Sprainbrook 345KV Y49 line tripped	Resolved Time With Coned.	Z1 Phase
16:11:22		EMS	RGE	Allegany Steam Generator tripped		
16:11:22		EMS	ISO-NE	Long Mt.-Plumtree 345KV 321 line tripped		
16:11:23	500	SDAC	O&R	Ladentown-Buchanan S. 345KV Y88 line tripped	Remote End – Cecony Sdac Confirmed	Ladentown – Line Y88 Porladentown – 21Zone 1 (Skdu) ladentown 50 – Phase 1, 2, 3

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:11:23	503	EMS	ConEd	Dunwoodie-Shore Road 345KV Y50 line tripped	Other Terminal At Lipa86-1a/y50 Zone 1 Trips Locally At Dunwoodie, And Sends Direct Trip To Shore Rd. Via 86-4/y50. Resolved Time With Lipa	Dunwoodie 345kv85-1a/y50 (Sel 311l) Zone1 87 Diff A,b,c Phase, 86-1a/y50, 86-4/y50
16:11:23	503	LIPA IRIG	LIPA	Dunwoodie-Shore Road 345KV Y50 line tripped	Resolved Time With Coned	Dtt Received
16:11:23	566	DFR	Central Hudson	Roseton-Rock Tavern 345KV 311 line tripped		'311' Line A1 95a1x/ars
16:11:23		EMS	NYSEG	Coopers Corners-Rock Tavern 345KV 34 line tripped		50le - 3f Line Pickup
16:11:23		EMS	NYSEG	Fraser-Coopers Corners 345KV 33 line autoreclosed	Closed At Coopers Corners. Line I/s	
16:11:23		EMS	Entergy	Indian Point 3 Generator tripped	Time Matched With Coned. Target Info From Coned.	Buchanan1st Line: 2385x 86-1a/w96 86-1b/w96 Mc-ip3ar2nd Line: 2385x 86-2a/w96 86-2b/w96 Mc-ip3indian Point 3 (Entergy)6.9kv Bus Uv
16:11:23		EMS	LIPA	Locust Grove-Syosset 138KV 559 line tripped		None
16:11:24	308	DFR	Central Hudson	Rock Tavern Capacitor Bank #2 tripped		94db-2/ar (Undervoltage)
16:11:24		EMS	O&R	Burns-W. Haverstraw 138KV 531 line tripped		Burns - 50 Phase 1, 2, 321p Zone 1 (Dlp)
16:11:24		EMS	KeySpan Generation	Glenwood GT 2 Generator tripped	Nyiso Ems Time	

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:11:24		EMS	LIPA	Newbridge-East Garden City 138KV 462 line tripped		Abc Z1
16:11:24		EMS	O&R	Sugarloaf-Ramapo 138KV 26 line tripped		Ramapo – 21p (Sel311c) sugarloaf – 21p (Sel311c) shoemaker - No Trip
16:11:24		EMS	O&R	W. Nyack-Lovett 138KV 562 line tripped		West Nyack – 21-zone 1, Phase 3 (Dlp)
16:11:25		EMS	Mirant	Rio 2 Generator tripped		Loss Of Ss
16:11:26		EMS	LIPA	Northport-Pilgrim 138KV 677 line tripped		Abc Z3
16:11:27		EMS	Niagara Mohawk	N. Scotland-Alps 345KV 2 line tripped		21p/67np (Sel321)- Inst Zone1 Abc
16:11:27		EMS	KeySpan Generation	Ravenswood 2 Generator tripped	Using Approx. Time From Nyiso Ems	
16:11:28		EMS	LIPA	Northport-Pilgrim 138KV 679 line tripped		Bc Z3
16:11:28		EMS	KeySpan Generation	Port Jefferson ST 3 Generator tripped		Lor 86g, Main Transformer Over Current Relay (A,b, C Phase) , Volts/hertz Relay
16:11:28		EMS	KeySpan Generation	Port Jefferson ST 4 Generator tripped		Lor 86t, Relay #287, #302, Timer Relay Target, Line Distance Relay Target

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:11:29	418	DFR	ConEd	Spranbrook-East View-Buchanan 345KV W79/ W93 tripped	Audiotone Transfer Trip Receive From Sprain Brookcey-phase Distance Relay, Part Of Directional Comparison Blocking	Buchanan naa94a-1/ eastview Tone Receive naa94a-2/ eastview Tone Receive 86-2atnaa94a-2/sprain Brook86-1at(138kv Relay Targets)sprain Brook21c-1/fn6 A&bæ85a/ fn650-1/fn679t/ rns6
16:11:29	791	DFR	Niagara Mohawk	N. Scotland-Leeds 345KV 94 line tripped	Line Trip At New Scotland.	No Target
16:11:29	806	DFR	Niagara Mohawk	N. Scotland-Leeds 345KV 93 line tripped		Lpro Zone 1 Phase
16:11:29		EMS	O&R	Lovett #3 Generator tripped	Mirant Unit	
16:11:29		EMS	Mirant	Rio 1 Generator tripped		Loss Of Ss
16:11:30	190	DFR	Dynegy	Roseton #2 Generator tripped	Breakers Opened	
16:11:30		EMS	Niagara Mohawk	Edic-New Scotland 345KV 14 line closed	Line Reclosed At Edic (I.e. Line Closed)	
16:11:30		EMS	O&R	Lovett #5 Generator tripped	Mirant Unit	
16:11:33	500	SDAC	NYISO	Ladentown-Buchanan S. 345KV Y88 line reclose		
16:11:33			NYPA	Fraser SVC	Returned To Service/then Re-tripped	
16:11:36	512	DFR	Reliant Energy	Astoria 4 Generator tripped		
16:11:36		EMS	Reliant Energy	Astoria 2 Generator tripped		

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:11:36		EMS	Reliant Energy	Astoria 3 Generator tripped		
16:11:36		EMS	Reliant Energy	Astoria 5 Generator tripped		
16:11:38		EMS	KeySpan Generation	Barrett 2 Generator tripped		Lor 86at, Loss Of Field Target
16:11:38		DFR	NYPA	Gilboa-Leeds 345KV GL-3 line tripped	Opened At Leeds	
16:11:39		EMS	Entergy	Fitzpatrick Generator trip		
16:11:42		EMS	Mirant	Mongaup 1-4 Generators tripped		Loss Of Ss
16:11:45		EMS	ISO-NE	Northport-Norwalk 138KV 1385 line tripped	Transfer Trip From Northport. Relay Info From Lipa. Sdac Confirm At 16:11:46.0	C Phase Oc
16:11:46		EMS	Niagara Mohawk	N. Scotland-Alps 345KV 2 line closed then tripped		
16:11:47		EMS	ConEd	Bowline 1 Generator tripped	Mirant Unit	
16:11:47		SER	NYPA	Fraser-Gilboa 345KV GF5-35 line reclosed	Closed At Gilboa. Line I/s. Sdac Confirm At 16:11:47.5	
16:11:47		EMS	Niagara Mohawk	Leeds-Gilboa 345KV 3 line tripped		No Target
16:11:50		EMS	Dynegy	Danskammer #2 Generator tripped	Dynegy Trip	
16:11:50		EMS	O&R	Lovett #4 Generator tripped	Mirant Unit	
16:11:51	12	DFR	Niagara Mohawk	N. Scotland-Leeds 345KV 94 line closed	Line Close At New Scotland.	
16:11:51	943	DFR	Niagara Mohawk	Scriba-Nine Mile Point 2 345KV 23 line tripped		Dtt
16:11:52		EMS	KeySpan Generation	Montauk Diesel 2 and 4 Generators tripped		

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:11:53	800	SDAC	Niagara Mohawk	Porter-Rotterdam 230KV 31 line closed	Line Close At Porter. Line I/s. Sdac Confirm.	
16:11:53		EMS	ConEd	Harlem River GT #2 Generator tripped	Nypa Unit	
16:11:54		EMS	Constellation Power Source	Nine Mile Point 1 Generator tripped		
16:11:57	312		IMO	IMO-Michigan L4D trip		
16:11:57	362		IMO	IMO-Michigan L51D trip		
16:12:00		EMS	Mirant	Bowline 1 Generator tripped		
16:12:00		EMS	Mirant	Bowline 2 Generator tripped		
16:12:00			Trigen Syracuse Energy Corp	Syracuse Trigen tripped		
16:12:00		EMS	AES Corp.	Westover unit #7 tripped	Aka Goudey	
16:12:00		EMS	AES Corp.	Westover unit #8 tripped	Aka Goudey	
16:12:02	246	EMS	Sithe Energies Inc.	Sithe GT #1 Generator tripped		
16:12:02	445	EMS	Sithe Energies Inc.	Sithe GT #2 Generator tripped		
16:12:02	460	EMS	Sithe Energies Inc.	Sithe GT #4 Generator tripped		
16:12:02	929	EMS	Sithe Energies Inc.	Sithe GT #3 Generator tripped		
16:12:02		DFR	NYPA	Harlem River GT #2 Generator tripped		Turbine Flame Out From Loss Of Station Service
16:12:02		EMS	Constellation Power Source	Nine Mile Point 2 Generator tripped		
16:12:02		EMS	KeySpan Generation	Ravenswood 3 Generator tripped		Electrical Fault
16:12:04	486	EMS	Sithe Energies Inc.	Sithe ST #5 Generator tripped		Logic, Both Associated Gt Units Off Line

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:12:05	500	SDAC	ConEd	Ladentown-Buchanan S. 345KV Y88 line tripped	Sdac Confirm	Ladentown zone 1 (Portt) buchanan none Recorded
16:12:07		SER	NYPA	Poletti Generator tripped		
16:12:09		DDR	RGE	Ginna Generator tripped		
16:12:09		EMS	ConEd	Hellgate GT #1 Generator tripped	Nypa Unit	
16:12:11		EMS	NRG	Huntley 67 Generator tripped		None
16:12:12	676	EMS	Sithe Energies Inc.	Sithe ST #6 Generator tripped		Logic, Both Associated Gt Units Off Line
16:12:12			NYPA	Fraser SVC tripped		
16:12:15		EMS	ConEd	Poletti Generator tripped	Nypa Unit	
16:12:19		EMS	NRG	Dunkirk #2 Generators tripped		None
16:12:19		EMS	KeySpan Generation	East Hampton GT Generator tripped		
16:12:20		EMS	AES Corp.	Greenidge unit #3 tripped		Operator Trip - Boiler Instability
16:12:23		EMS	ConEd	Roseton-East Fishkill 345KV 305 line tripped	Other Terminal At Roseton (Chg&e).	East Fishkillnot Available
16:12:25		EMS	ConEd	Waterside 9 Generator tripped	According To Station Soe And Alarm The Unit Tripped At 4:10:44	Watersidenot Available Yet
16:12:27		EMS	ConEd	Arthur Kill 3 Generator tripped	Nrg Unit	
16:12:28		EMS	ConEd	East River 6 Generator tripped		East Riverno Targets
16:12:28		EMS	Cayuga Energy	South Glens Falls Generator tripped		
16:12:30		EMS	O&R	Bowline 1 Generator tripped	Mirant Unit	
16:12:30		EMS	ConEd	East River 7 Generator tripped		East Riverno Targets

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:12:48		EMS	Niagara Mohawk	N. Scotland-Alps 345KV 2 line closed		
16:12:49	700	SDAC	Niagara Mohawk	Dunkirk-S. Ripley 230KV 68 line closed	Line Reclosed At Dunkirk	
16:12:50	500	SDAC	Niagara Mohawk	S. Ripley-Erie South 230KV 69 line tripped	Line Trip At S. Ripley.	30bf/69
16:12:50		EMS	Niagara Mohawk	Dunkirk-S. Ripley 230KV 69 line tripped	Line Trip At S. Ripley	
16:13:08		EMS	NRG	Dunkirk #1 Generator tripped		None
16:13:21		EMS	Mirant	Lovett #5 Generator tripped		
16:13:24		EMS	KeySpan Generation	Far Rockaway 4 Generator tripped		No Targets
16:13:24		EMS	LIPA	Northport-Pilgrim 138KV 672 line tripped		None
16:13:29		EMS	Mirant	Lovett #4 Generator tripped		
16:13:42		EMS	KeySpan Generation	Glenwood ST 4 Generator tripped	Nyiso Ems Time	Loss Of Excitation/reverse Power
16:13:42		EMS	KeySpan Generation	Glenwood ST 5 Generator tripped	Nyiso Ems Time	Loss Of Excitation/reverse Power
16:13:45		EMS	ConEd	Astoria 2 Generator tripped	Reliant Units	
16:13:55		EMS	KeySpan Generation	Northport 1 Generator tripped	Went To 0 Mw At 16:13:55	Lor 86t, Reverse Power Relay, Acb-430 Aux Transformer, Fan Control Pjc Relay Phase "B", "A" Id Fan Time Over Current "B" Phase Of High Speed Windings
16:13:56	968	EMS	HQ	Beauharnois A1 Generator tripped		

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:14:02		EMS	KeySpan Generation	Northport 4 Generator tripped		86t, 86g1, Reverse Current Relay, Over Frequency Trip, Gcb – 1340 Closing Time
16:14:22		EMS	KeySpan Generation	Northport 3 Generator tripped		Lor 86t, Reverse Power Relay, “B” Fd Fan, Time-over Current On “A” Phase
16:14:38		SEL	Niagara Mohawk	N. Scotland-Alps 345KV 2 line tripped		
16:14:47		EMS	NYSEG	Homer City-Watercure 345KV 30 line autoreclosed	Sdac Confirm At 16:14:45.4	
16:15:00			MISO	Sammis-Star 345KV line tripped and reclosed		
16:15:06		EMS	NYSEG	Homer City-Watercure 345KV 30 line tripped		Dtt From Homer City
16:15:07		EMS	Niagara Mohawk	Rotterdam-Bear Swamp 230KV E205 line tripped	Line Trip At Rotterdam.	Gcy 21-zone 1
16:15:57	418	EMS	Dynegy	Danskammer #3 Generator tripped	Dynegy Trip	
16:16:07	579	EMS	Dynegy	Danskammer #4 Generator tripped	Dynegy Trip	
16:16:39		EMS	KeySpan Generation	Northport 2 Generator tripped		Lor 86t
16:17:00			MISO	Fermi Nuclear tripped		
16:17:04	138	EMS	HQ	Beauharnois A23 Generator tripped		
16:17:11	970	EMS	HQ	Beauharnois A24 Generator tripped		
16:17:35			Calpine Energy Service	Kiac Steam Generator tripped		

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:17:37			Calpine Energy Service	Kiac GT #2 and #1 Generators tripped		
16:17:51	390	EMS	HQ	Beauharnois A25 Generator tripped		
16:17:58			Cayuga Energy	Carthage Generator tripped		
16:18:43		EMS	AES Corp.	Cayuga unit #1 Generator tripped	Aka Milliken	
16:18:54		EMS	LIPA	L. Success-Jamaica 138KV 903 line tripped	Opened By District Operator	None
16:19:00		EMS	Indeck	Indeck-Oswego Generator tripped		Plant Trip - R-15 Open; 51v On Grid
16:19:11		EMS	LIPA	Valley Stream-Jamaica 138KV 901 line tripped	Opened By District Operator	None
16:20:00		EMS	ConEd	Underfrequency Load Shed	95.3 Mw	
16:20:25		EMS	ConEd	Astoria 4 Generator tripped	Reliant Units	
16:20:59		EMS	ConEd	Astoria 3 Generator tripped	Reliant Units	
16:21:37		EMS	ConEd	Ravenswood GT6 Generator tripped	Keyspan Unit	
16:22:15		EMS	ConEd	Ravenswood GT7 Generator tripped	Keyspan Unit	
16:22:43		EMS	LIPA	Northport-Elwood 138KV 681 line tripped		Events / Targets Overwritten
16:22:45	98	DFR	Niagara Mohawk	N. Scotland-Leeds 345KV 94 line tripped	Line Trip At New Scotland.	No Target
16:22:52			NYPA	SL Sync Cond #1tripped		

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:22:53		SER	NYPA	Plattsburgh-Saranac 115KV 1 line tripped		
16:22:55		EMS	ConEd	Arthur Kill 2 Generator tripped	Nrg Unit	
16:22:57	800	EMS	Niagara Mohawk	Porter-Rotterdam 230KV 30 line closed	Line Close At Rotterdam. Line I/s. Sdac Confirm	
16:23:00		EMS	Niagara Mohawk	Rotterdam-Bear Swamp 230KV E205 line closed	Line Close At Rotterdam.	
16:23:05		SER	NYPA	Plattsburgh-Saranac 115KV 1 line reclose	Closed At Plattsburgh	
16:23:14		EMS	PSEG	Albany 2 Generator tripped	Nyiso Ems Time	
16:23:20		EMS	LIPA	Northport-Elwood 138KV 678 line tripped		Ab Z2
16:23:44		EMS	NRG	Dunkirk #4 Generator tripped		None
16:27:42		SER	NYPA	Alcoa Potline #6 restored		
16:28:38		SER	NYPA	Alcoa Potline #6 tripped		
16:34:38		EMS	RGE	Allegany Gas Generator tripped		
16:35:02	521	EMS	AES Corp.	Somerset Generator tripped	1 Tripped Offline As A Result Of An Operator-initiated Trip, Subsequent To An Automatic Trip Of The Unit Boiler. No Protective Relaying Was Involved. The Boiler Tripped Due To The Inability Of The Controls To Respond To The Excessive System Load Fluctuations. Our Ser Indicates The Generator Breaker Opened At 16:32:46.527	

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
16:35:25		SER	NYPA	Moses-Adirondack 230KV MA-1 line tripped	Opened At Moses	
16:35:59		DFR	NYPA	Fraser-Gilboa 345KV GF5-35 line tripped	Opened At Bg(Operator Action). Buses Were Stripped To Initiate Blackstart Procedures. Sdac Confirm At 16:36:00.1	
16:35:59		DFR	NYPA	Gilboa-Leeds 345KV GL-3 line tripped	Opened At Bg(Operator Action). Buses Were Stripped To Initiate Blackstart Procedures	
16:35:59		DFT	NYPA	Gilboa-N. Scotland 345KV GNS-1 line tripped	Opened At Bg(Operator Action). Buses Were Stripped To Initiate Blackstart Procedures	
16:36:13		SER	NYPA	Moses-Plattsburgh 230KV MWP-1 line tripped	All 3 Terminals Opened – Moses, Willis & Platts.	Abc, M-86ttb, W-86ttb
16:37:42		SER	NYPA	Alcoa Potline #6 restored		
16:38:38		EMS	Central Hudson	Rock Tavern 345/115KV xfmr 1 tripped	Supervisory Control	
16:38:51		EMS	Central Hudson	Rock Tavern 345/115KV xfmr 3 tripped	Supervisory Control	
16:43:18		EMS	NRG	Dunkirk #3 Generator tripped		None
16:46:57		EMS	Central Hudson	Hurley Ave 345/115KV xfmr 1 low side opened	Supervisory Control	
16:47:45		EMS	Central Hudson	Pleasant Valley 345/115 xfmr 1 low side opened	Supervisory Control	
16:54:26		EMS	AES Corp.	Cayuga unit #2 Generator tripped	Aka Milliken	
17:02:09		EMS	O&R	W. Haverstraw 345/138KV Bank 194 tripped		

Time	Time Ms	Time Source	Owner	Event	Notes/comments	Targets
17:03:13		EMS	RGE	Station 80 345kV Bus #1 restored		
17:05:32		EMS	O&R	Ladentown-Ramapo 345KV W72 line tripped		
17:05:32		EMS	O&R	Ladentown-W. Haverstraw 345KV L67 line tripped		
17:20:28		EMS	O&R	S. Mahwah 345/138KV Bank 258 tripped		
18:02:23		EMS	NYSEG	Fraser 345/115/34.5 KV Bank #2 tripped		59 (Over Excitation)
18:02:28		EMS	NYSEG	Coopers Corners 345/115/34.5 KV Bank #3 tripped		59 (Over Excitation)
18:04:36		EMS	NYSEG	Coopers Corners 345/115/34.5 KV Bank #2 tripped		59 (Over Excitation)
18:22:32		EMS	NYSEG	Oakdale 345/115/34.5 KV Bank 2 tripped		59 (Over Excitation)

APPENDIX B

DOE FINAL REPORT

Includes Recommendations from Various Reports

Blackout Investigation – NYISO Follow-up Items Department of Energy (DOE) Final Report Released April, 2004 (updated January 5, 2005)				
Recommendation			**NYISO Status Due Date**	**Comments**
1		Make reliability standards mandatory and enforceable, with penalties for noncompliance. Reliability standards should allow, where appropriate, flexibility to accommodate regional differences, including more stringent reliability requirements in some areas.	On-Going	FERC affirmed that compliance with reliability standards is under its tariff as part of "good utility practices."
2		Develop a regulator-approved mechanism for funding NERC and the regional reliability councils, to ensure their independence from the parties they oversee.	On-Going	NYISO initiated discussion with the IRC in November 2004. Further action is dependent on the passage of energy legislation and the establishment of an ERO. (Same as NYISO Interim Report Recommendation #1)
3		Strengthen the institutional framework for reliability management in North America. Commission independent review in organizational design on how to structure a reliability organization. Role of regional councils in reliability.	On-Going	Regional Managers Committee issued a report to NERC Board of Trustees - October 5, 2004
4		Clarify that prudent expenditures and investments for bulk system reliability (including investments in new technology) will be recoverable through transmission rates.	December 2004	FERC issued Order in December 2004, accepting in part and rejecting in part, tariff amendments associated with the NYISO Comprehensive Reliability Planning Process.
5		Track implementation of recommended actions to improve reliability. Quarterly reporting to NERC and council.	Quarterly reporting through NPCC Council under way July 2004, October 2004, December 2004	
6		FERC should not approve the operation of a new RTO or ISO until the applicant has met the minimum functional requirements for reliability coordinators.	On-Going	The NYSIO will monitor ISO/RTO fillings and submit comments as appropriate.
7		Require any entity operating as part of the bulk power system to be a member of a regional reliability council if it operates within the council's footprint.	Complete	The NYISO is part of NPCC.
8		Shield operators who initiate load shedding pursuant to approved guidelines from liability or retaliation.	In process – Due December 31st	Currently Under Development
9		Integrate a "reliability impact" consideration into the regulatory decision-making process.	December 2004	FERC issued an Order in December 2004
10		Establish an independent source of reliability performance information.	TBD	DOE/EIA Reporting modifications
11		Establish requirements for collection and reporting of data needed for post-blackout analysis.	March 31, 2005	RWG performing analysis report; completion expected in March 2005

Recommendation			NYISO Status Due Date	Comments
12		Commission an independent study of relationships among industry restructuring, competition and reliability.	Ongoing	Incorporate as a component in the NPCC Regional Planning Initiative
13		DOE should expand its research programs on reliability-related tools and technologies.	DOE Initiative	Multiple initiatives, e.g. phasor requirements; NYISO tied into TVA, need data from NYPA
14		Establish a standing framework for the conduct of future blackout and disturbance investigations.	DOE Initiative	
15		15. Correct the direct causes of the August 14, 2003 blackout	Completed	
15	a	Interim voltage criteria		Action Taken: The NYISO has an existing voltage criterion, which has been in place for several years as part of it's operating procedures. It was recently reviewed and was found to be well above the guide-lines recommended. No changes have been made to the procedure.
15	b	Reactive resources		Action Taken: Special attention and review was given and has been completed as part of the Summer Operating Study Review and the Athens Voltage Study. All reactive devices are available for the sum-mer '04.
15	c	Operational preparedness and action plan		Action Taken: The NYISO has com-pleted an Alternate Control Center test and Restoration Drill during 2Q04
15	d	Emergency response resources		Action Taken: The NYISO has completed testing of the EDRP and SCR programs in preparation of the Emergency response resources.
15	e	Emergency response plan		Action Taken: The NYISO Emer-gency Response Plan has recently been reviewed with SOAS and the Operating Committee detailing the emergency procedures prior to the summer '04

Recommendation			NYISO Status Due Date	Comments
15	f	Operator communications		Action Taken: The NYISO System Operators participated in the NPCC spring seminar with representatives from the neighboring control areas. In addition, the system operators attended SOTS training with local transmission operators, which focused on communication protocols.
15	g	Reliability monitoring emergency preparedness training for operators		Action Taken: The NYISO System Operators have completed five days of emergency preparedness training.
15	h	Operating Agreements		Action Taken: The NYISO has in place emergency operating agreements with neighboring control areas. In addition the NYISO has an existing NYISO/TO agreement detailing the roles and responsibilities of each party.
16		Establish enforceable standards for maintenance of electrical clearances in right-of way areas. PSC manages vegetation on R-O-W and the NYISO will track vegetation tripouts on bulk power facilities.	NERC Standard	Outage reporting requirements are incorporated in the NERC 2004 Compliance Template and are also incorporated in the draft standard.
17		Strengthen the NERC Compliance Enforcement Program. Will require region council quarterly reporting. Compliance audits and public release of audit reports.	Completed July 6, 2004	The NYISO Audit occurred on April 13-15 and a formal report was issued in July '04.
18		Support and strengthen NERC's Reliability Readiness Audit Program	Completed July 6, 2004	The NYISO Audit occurred on April 13-15 and a formal report was issued in July '04.
19		Improve near-term and long-term training and certification requirements for operators, reliability coordinators, and operator support staff.		NERC preparing scope for long term study.
19	a	Require training for planning staff	19 a. Completed	
19	b	Training for IT support staff	19 b. Completed	FERC also initiated a study.
19	c	Commission an advisory report by independent panel to address training issues	19 c. NERC Initiative	NERC included money in 2005 budget. Presentation at NERC OC in November 2004.
20		Establish clear definitions for normal, alert and emergency operational system conditions. Clarify roles, responsibilities and authorities of reliability coordinators and control areas under each condition.	Completed	Modifications of Policies 5, 6, and 9 provide necessary communication coordination details.

Recommendation			NYISO Status Due Date	Comments
21		Make more effective and wider use of system protection measures.		NPCC TFSP and NYISO SPAS
21	d	Zone 3 relay	21 d. Completed	NERC SPCTF
21	e	Under-voltage load shedding		
21	f	Use of UFLS and UVLS		Planning Committee recommendations (NERC #8a)
22		Evaluate and adopt better real-time tools for operators and reliability coordinators. (NERC #10) a) Wide-area situational displays systems Independent testing and certification of industry EMS and SCADA systems.	December 31,2004	Wide Area ACE displays have been installed in the NYISO control room for Summer '04. NERC has established a task force to develop guidelines, recommendations due December 31, 2004. NERC OC approved scope of Real Time Tools Best Practice Task Force.
23		Strengthen reactive power and voltage control practices in all NERC	December 31,2004	Phase I of the NYISO Reactive Study has been completed. Phase II is underway with completion in June 2005.
24		Improve quality of system modeling data and data exchange practices	NERC Initiative	Regulator Approved template.
25		NERC should reevaluate its existing reliability standards development process and accelerate the adoption of enforceable standards	December 31,2004	NERC "Version 0" Standards have been approved by stakeholders and will go to the Board of Trustees in February 2005.
26		Tighten communications protocols especially for communications during alerts and emergencies. Upgrade communication system hardware where appropriate.	Completed	NPCC protocols exists; NERC OC agreed to allow the Reliability Coordinators to implementa a proposed Hotline procedure for field testing.
27		Develop enforceable standards for transmission line ratings. NYSRC has tie-line rating report for rating transmission lines.	Completed	NYSRC Standards
28		Require use of time-synchronized data recorders.	NPCC TFSP, NYISO SPAS	
29		Evaluate and disseminate lessons learned during system	Completed	NYISO Restoration report, NPCC Restoration Report, NPCC, ECAR & PJM have formed a team to evaluate the restoration after 8/14/03 working with RCWG; Report to Board 2005
30		Clarify criteria for identification of operationally critical facilities and improve dissemination of updated information on unplanned outages.	Completed	NPCC protocols exists; Updating SDX automatically needs to be completed. Additional functionalitiy was added to the NERC RCIS and SDX applications to allow for the posting of forced outages. NERC already includes SOL and IROL definitions in its latest revisions to Policies 5, 6, and 9.

Recommendation			NYISO Status Due Date	Comments
31		Clarify that the transmission loading relief (TLR) process should not be used in situations involving an actual violation of an Operating Security Limit. Streamline the TLR process	Completed	NYISO does not use TLR; NERC OC agreed that Policy 9F.1 provides the Reliability Coordinator with the latitude to mitigate System Operating Limit and Interconnected Reliability Operating Limit violations.
32		Implement NERC IT standards (Physical and Cyber security)	Completed	Cyber standards completed effective date 1Q04
33		Develop and deploy IT management procedures with regards to EMS automation.	December 2004	Implementation to commensurate with SMD2 go live date
34		Develop corporate-level IT security governance and strategies Recommends that organization have a planned and documented security strategy, governance model, and architecture for EMS automation systems.	Completed	Development and implementation of IT Risk Mgmt Procedure and IT Security Responsibility Matrix.
35		Implement controls to manage system health, network monitoring and incident management.	Completed	Implementation of BMC, IDS on-going for NYISO production systems.
36		Initiate a U.S. –Canada risk management study dealing with vulnerabilities of shared electric infrastructure and cross border interdependencies	On-Going	Initiate Regional discussion at the Winter 2005 NIMOCC meeting.
37		Improve IT forensic and diagnostic capabilities. IT support personnel for EMS automation systems are familiar with the systems design and implementation	On-Going	Implementation of BMC, IDS on-going for NYISO production systems.
38		Assess IT risk and vulnerability at scheduled intervals	On-Going	On-going efforts by IT and Internal Audit
39		Develop capability to detect wireless and remote wire line intrusion and surveillance	On Track	Full Implementation to be completed 4Q04
40		Control access to operationally sensitive equipment	Completed	NYISO uses an electronic card access system that limits entry to sensitive areas (such as the electric system control room and computer command center) to specifically authorized individuals.
41		NERC should provide guidance on employee background checks	Completed	NYISO review complete.
42		Confirm NERC ES-ISACs the central point for sharing security information and analysis	Completed	

DOE Final Report continued ...

Recommendation			NYISO Status Due Date	Comments
43		Establish clear authority for physical and cyber security.	Completed	The Board of Directors established Chief Administrative Officer (CAO) position in late 2003 with overall responsibility for assuring the development of enterprise wide physical and cyber security programs. The Manager of Security reports directly to the CAO and is responsible for the implementation of physical security programs. The Chief Information Officer reports directly to the CEO and is responsible for the implementation of cyber security programs.
44		Develop procedures to prevent or mitigate inappropriate disclosure of information	Completed	Refer to Policies 12-03, 5-1, 6-1, 6-7, 8-1, 10-2, 12-2, and 13-03 in the NYISO Administrative Policies and Procedures Manual, and the MMU Confidentiality Policy.

Blackout Investigation – NYISO Follow-up Items
New York State PSC Interim Report
Released — February 2004

Recommendation	NYISO Status	Comments
More robust battery back-up capacity should be installed by the electric utilities, the NYISO, and Verizon to power electronic security hardware. For more sensitive and critical facilities and equipment, back-up power should be augmented with standby emergency generators or fuel cells capable of supporting security systems operations for a reasonable time period.	Completed	The NYISO has robust UPS capability at its PCC and ACC facilities to power mission critical systems. The NYISO also has robust back-up diesel generation capability installed at its PCC and ACC facilities.
The electric utilities, the NYISO, and Verizon should reinforce emergency mobile radio capacity to present a viable back-up communications system. Mobile radio back up should provide consistent transmission/reception coverage at key company facilities and undergo regular reliability testing and battery charging.	Completed	Multiple contingency plans and mobile systems being explored. Confirmed by Nextel that their phone "Push to talk" is an independent radio system from their cellular service.
The electric utilities, the NYISO, and Verizon should explore the feasibility of acquiring Wireless Priority Service and satellite telephone service for security purposes.	Completed	NYISO has requested Nextel and Verizon to provide Wireless Priority Service as soon as it is available by their companies.
The electric utilities, the NYISO, and Verizon should implement, if they have not done so already, a centralized identification and access system. Databases should be updated daily and programmed to sound an alarm at security offices if unauthorized access is attempted.	Completed	The NYISO has implemented an electronic card access program with related database and alarming features.
The electric utilities, the NYISO, and Verizon should review the adequacy of its patch management program and implement necessary improvements.	On-Going	Program in Place, recent audit passed
The electric utilities, the NYISO, and Verizon should thoroughly review their back-up power requirements for sustaining operation of essential information technology (IT) network components.	Completed	The NYISO has robust UPS capability at its PCC and ACC facilities to power mission critical systems. The NYISO also has robust back-up diesel generation capability installed at its PCC and ACC facilities.

NPCC Inter-Control Area Restoration Coordination Working Group (Working Group CO-11) Recommendations

Recommendation	Group/Responsibility	Status
Synchronizing of Electrical Islands - The IRCWG recommends that guidelines for matching voltage and frequency for the manual re-synchronization of electrical islands be developed and incorporated in the "NPCC Inter-Control Area Power System Restoration Reference Document." These guidelines are then to be incorporated in each Area restoration plan to facilitate Area to Area re-synchronization, where applicable.	IRCWG	IRCWG in the process of reviewing draft revisions to the Reference Document.
Inadvertent Re-Synchronization - The IRCWG recommends that each Area review the synchronization made between electrical islands by automatic re-closing and determine if these re-closures were a) appropriate b) consistent with the normal, steady state design intent of the automatic re-closing systems; c) acceptable for the rare event which occurred on August 14, 2003. The IRCWG recommends that the inadvertent synchronization done manually be investigated, and methods to avoid manual inadvertent synchronizations in the future should be identified. Results should be incorporated into switching procedures and training.	NPCC Task Force on System Protection (TFSP) and IRCWG	TFSP has reviewed and is considering reivsions to the B-1 Reclosing Guide.
Stabilization of Surviving Electrical Islands - The IRCWG recommends that each Area review its restoration plan to address the actions necessary to stabilize operations in the remaining electrical islands following a major system separation.	IRCWG	IRCWG area representatives asked to review restoration plans to ensure stabilization is included. Ongoing review of Document A-3 draft revisions.
Load Shedding - The IRCWG recommends that each Area ensure that its load shedding capability remains viable in restoration situations following a major system disruption.	IRCWG	Ongoing review of Document A-3 draft revisions.
Operator Authority - The IRCWG recommends that each Area continue to emphasize in its system operating procedures, job descriptions and operator training that its system operators possess the authority to take any action required, including load shedding, to comply with the NPCC Criteria and NERC requirements.	Requested that this recommendation be endorsed by the appropriate executive of each NPCC Member.	4 out of 5 areas have responded to letters sent requesting confirmation of Area Operator LS Authority.

Recommendation	Group/Responsibility	Status
Restoration Training - The IRCWG recommends that NPCC develop plans for inter-Aera restoration training drills, including those participants critical to restoration (such as Transmission Operators and Satellite Control Centers), simulating the restoration, the scope of which can include whole or partial Areas.	IRCWG in coordination with the NPCC Working Group on Dispatcher Training (CO-2)	C0-2 is planning a complete Spring 2005 SO Seminar on Restoration with a region-wide exercise.
Communications Management - The IRCWG recommends that each Area review its voice telecommunication facilities and procedures to identify means to better: 1) manage call volume information, 2) prioritize communications, 3) disseminate necessary information during major system emergencies.	Task Force on Infrastructure Security and Technology (TFIST)	TFIST has had preliminary discussions.
Alarm Management - The IRCWG recommends that each Area review the ability of its Energy Management System (EMS) to buffer and prioritize alarms during a major system disturbance.	Working Group on System Operational Tools (CO-10)	IRCWG has had discussions with C0-10 Chair and requested each area report on their EMS.
Wide Area View - The IRCWG reommends that each Area provide its system operators with enhanced capabilities to permit a wide area view which will permit a more rapid assessment of the state of the interconnected bulk power system following a large scale system disturbance.	Working Group on System Operational Tools (CO-10)	IRCWG has had discussions with C0-10 Chair and requested each area provide an update.
Testing of Key Facilities & Associated Critical Components - NPCC Document A-03, “Emergency Operation Criteria,” defines a comprehensive program to identify, monitor and test the key facilities and associated critical componenets required to establish a basic minimum power system for purposes of restoration. The IRCWG recommends that this testing program be further strengthened by incorporating these criteria requirements in NPCC Document A-08, “NPCC Reliability Compliance and Enforcement Program.”	NPCC Compliance Monitoring and Assessment subcommittee (CMAS)	Ongoing review of Document A-3 draft revisions.

Working Group CO-11 Recommendations continued ...

Recommendation	Group/Responsibility	Status
Restoration Criteria and Guides - The IRCWG recommends that the NPCC Document A-03, "Emergency Operation Criteria," and the "NPCC Inter-Control Area Power System Restoration Reference Document" be reviewed to incorporate lessons learned from the restoration efforts.	IRCWG	Ongoing review of Document A-3 draft revisions.
Fuel Supply for Emergency Generators - The IRCWG recommends that the NPCC Document A-03, "Emergency Operation Criteria," be modified to add a requirement to address adequate on-site fuel supplies for stand-by emergency generators associated with key facilities for restoration.	IRCWG	Ongoing review of Document A-3 draft revisions.

Blackout Investigation – NYISO Follow-up Items
NYISO Interim Report
Released — January 8, 2004

Recommendation	NYISO Status	Comments
The reliability standards set by NERC, which are now voluntary, must be made mandatory, as are the NPCC and NYSRC rules.	On-Going	FERC affirmed that compliance with reliability standards is under its tariff as part of "good utility practices." (same as DOE#1)
The communications among ISOs, RTOs, and control areas need to be significantly improved.	Completed	NERC has established a telephone conference bridge that will serve as the Reliability Coordinator hotline.
Better communications among the control area operators need to be accompanied by pre-arranged and effective operating procedures.	Completed	The Reliability Coordinator Working Group implemented new procedures for the NERC Hotline Process.
Participation in an ISO, RTO or tight power pool for reliability purposes should be mandatory. (see DOE #7)	On-Going	The NYISO continues to promote its position in the appropriate forums.
The energy bill before Congress contains several provisions intended to encourage investment in transmission and to improve generation siting processes thus strengthening and modernizing the grid. (See DOE #4)	On-Going	The NYISO continues to promote its position in the appropriate forums.

NYISO Restoration Working Group Recommendations				
No.	**Recommendation**	**Action Steps**	**Actions**	**Action Taken**
3.1.1	NYISO Restoration Plan - Extend the 345 kV backbone restoration path from the Dunwoodie Substation in Yonkers down through the Rainey, Farragut, Gowanus, Goethals and Fresh Kills 345 kV Substations establishing a path through the boroughs of Queens, Brooklyn and Staten Island. This change will provide an energized path to a potential 8000 MW of generation located in Con Edison's territory south of the Dunwoodie interface. Providing a synchronized source and transmission outlet, as well as, light and power to these major generation sites will expedite the local restoration process. (Note: this change will require the reservation of generating capacity north of Dunwoodie for voltage control as feeders are energized to the south).	1	Con Edison to conduct internal studies to analyze technical issues involved with the extension of the NYISO 345 kV "backbone" through its service territory. Initial results to be presented to the RWG in early fall.	Preliminary results of Internal studies conducted by Con Edison were presented to the RWG in October 2004.
		2	Load blocks needed to support backbone extension to be identified.	Preliminary results identified load required to control voltage during the restoration of the extended backbone.
		3	Con Edison and NYISO staff to work together to integrate the Con Edison system into "The Plan".	The RWG requested NYISO Operations Engineering to evaluate the Con Edison preliminary studies at the October 2004 SOAS meeting. This will need to be brought to the Project Prioritization Team to see if it is possible for NYISO staff to complete this in time to implement the changes to the Restoration Plan prior to Summer 2005.
		4	The NYISO and Con Edison will propose extension of The Plan to the RWG/SOAS/ OC, which will include proposed updates to the Restoration Switching Diagram.	

NYISO RWG Recommendations continued ...

No.	Recommendation	Action Steps	Actions	Action Taken
3.1.2	NYISO Restoration Plan - Coordinate black start capability for participating generating units located in the Con Edison service territory south of the Dunwoodie Interface as soon as feasible. It is imperative that the black start capability of these generation sites be verified, i.e., confirm their ability to initiate startup of generator auxiliary equipment via their black start facilities and processes. This will ensure that these generating units will be ready to synchronize to the transmission outlets when made available to them.	1	SOAS to assign the RWG the task to investigate the technical issues associated with blackstart procedures for generating units which can facilitate either the statewide or local TO blackstart plans.	
		2	RWG will initially establish definitions for blackstart resources and ensure that they are consistent with those used by other NPCC/ NERC guidelines.	Several definintions of blackstart resources taken from NERC, NPCC, NYISO & PJM publications were reviewed at RWG. RWG concluded that the NYISO Black Start definition is consistent with industry standards. No changes will be recommended.
3.1.3	NYISO Restoration Plan - Expand the NYISO Restoration Plan to include the Sprainbrook 345 kV Substation. The Sprainbrook and Dunwoodie Substations should be tied together via feeder W75L/M to allow the option of using either Y-49 or Y-50 as the backbone link to Long Island. The equipment at the East Garden City (Y-49 terminal) is newer than at Shore Road (Y-50 Terminal) providing greater flexibility and reliability for synchronization to LIPA's 138 kV grid.	1	LIPA to send correspondence to the RWG indicating that either of the two options for tying the backbone into the Long Island grid are technically feasible.	LIPA sent corrspondence to RWG (e-mail dated July 14, 2004) indicating that all equipment is presently in-place to effect this change to the NYISO Backbone Restoration Plan.
		2	LIPA to conduct internal review of supply-side issues related to maintaining the integrity of the backbone once it is tied into Long Island.	LIPA has conducted an internal review and reported to the RWG that there are no problems related to supply side issues.
		3	NYPA/Con Ed/LIPA to make necessary changes to the various Y-49 operating agreements to allow for its use as an alternate backbone component. Analysis will investigate any changes which may be required to the Y-490 protective relaying schemes.	

NYISO RWG Recommendations continued ...

No.	Recommendation	Action Steps	Actions	Action Taken
		4	Con Edison, LIPA, NYPA, and NYISO staff to work together to integrate the Con Edison and LIPA systems into "The Plan".	
		5	The NYISO, Con Edison and LIPA will propose extension of The Plan to the RWG/ SOAS/OC, which will also include proposed updates to the Restoration Switching Diagram.	
3.2.1	Operator Training Enhancements - With due consideration to security issues, TOs should develop presentation materials and exercises on their restoration plans for the instruction of both generators in their area and NYISO Operations staff. Where possible, interactive computer simulations should be employed. This material should identify the black start capability in the area, the cold load requirements to bring each generator into service and the blocks of load required to energize the transmission system.	1	TOs to provide a description of training programs either currently in use or being developed and/ or enhanced based on recent NERC post-blackout directives by 9/1/2004.	Several TOs have submitted summaries of their operator training programs. A summary document will be posted to the RWG website later this fall.
		2	NYISO staff to gather descriptions of training programs used by other NPCC entities	
3.2.2	Operator Training Enhancements - TOs should annually conduct restoration seminars for generators in their area so that in the event of an emergency, all parties are aware of what needs to be done, and their role in the process. As a joint effort, Generators should participate and provide information and requirements for the start-up of their facilities.	1	TOs to identify start-up power and minimum voltage requirements for merchant generators in their control areas by 11/1/2004.	
		2	Gnerator Owners to confirm/modify information provided by the TOs.	

NYISO RWG Recommendations continued ...

No.	Recommendation	Action Steps	Actions	Action Taken
		3	Development of annual seminars shall follow completion of items to be completed as part of Recommendation 3.2.1.	
3.2.3	Operator Training Enhancements - TO Operators should attend the NYISO System Operator Training Seminar (SOTS). This is a semi-annual four day course on both power system and market operation. It includes segmenets on emergency operation and restoration.	1	SOAS shall monitor TO attendance patterns to ensure compliance with NYISO/NERC minimum training requirements.	NYISO Training Department has agreed to provide the maximum number of NERC Continuing Education Credits possible during SOTS programs. The NYISO TOs have indicated that they will work toward achieving 100% participation for the spring and fall SOTS sessions.
3.2.4	Operator Training Enhancements - Generator Operators should attend the NYISO's Generator Operator Training Seminar (GOTS). This is a two-day overview course on both power system and market operation; it includes a segment on restoration overview, at the statewide and TO level.	1	RWG (through SOAS) to review short history of participation patterns by Generator Operators in the GOTS program.	
		2	RWG to investigate the development of a one-day restoration overview for presentation to a joint Generator Operator/ TO audience as part of the Spring SOTS Program.	The spring 2005 SOTS program will include a one-day restoration activity segment that will involve both TOs and Generator Operators. This session will be in addition to the normal program and be held from 10:00 - 04:30 on Monday. Thereafter, this will become a regular feature of the spring SOTS program.
3.2.5	Operator Training Enhancements - The NYISO RWG should investigate the benefits of a second NYISO Restoration Drill in the fall of each year. These drills are typically performed on shift.	1	RWG to investigate the option of doing inter-control area tie-in exercises as part of a second annual NYISO drill to commence in the fall of 2005.	
		2	NYISO staff to establish contacts with other Control Areas to discuss the development of scripts for tie-in switching procedures. Begin with ISO-NE and expand to PJM and the IMO.	

NYISO RWG Recommendations continued ...

No.	Recommendation	Action Steps	Actions	Action Taken
3.2.6	Operator Training Enhancements - The NYISO Training Department should expand and enhance its restoration training tools by completing the following tasks: 1) Develop a restoration simulation exercise modeling each individual TO restoration plan, with special attention to how the plan interacts with the NYISO cross state restoration. 2) Develop a restoration tabletop exercise, which incorporates the simultaneous coordinated implementation of TO restoration plans and the NYISO cross state restoration. 3) Develop a method for TO System Operators, Generator Operators, and neighboring control area system operators to interactively, remotely, participate in restoration tabletop exercises.	1	NYISO Training Staff to identify feasible timeframes for implementing each of the above three tasks. Implementation plans will be dictated by personnel commitments to the SMD2 transition effort.	
3.3.1	Coordinated Emergency Response - Review and evaluate specific personnel roles, responsibilities, and staffing requirements at each control center for a set period following an event of this type.	1	TOs to provide a summary of actions taken and/or planned in response to both federal and state directives following the 2003 blackout by 9/15/2004	Several TOs have submitted summaries of their control center staffing roles and responsibilites. A summary document will be posted to the RWG website later this fall.
3.3.2	**Coordinated Emergency Response** - Establish a "command post" location at each control center to be dedicated for events similar to this that require phone centers and map boards for non-dispatch staff to coordinate activities off the dispatch floor.	1	TOs to provide a summary of actions taken and/or planned in response to both federal and state directives following the 2003 blackout by 9/15/2004	Several TOs have submitted summaries of their plans for establishing a "command post" within their control centers. A summary document will be posted to the RWG website later this fall.
3.4.1	**Emergency Communication** - Investigate the establishment of a formal process for disseminating system information to the TOs during a system disturbance enhancing the current process and procedures in place at the NYISO and at the TOs.	1	Procedures to be developed following completion of implementation plans for recommendations under Area 3.3 (Coordinated Emergency Response).	
		2	The NYISO will arrange a kick-off meeting with the Tos to be held later this year (2004).	
3.4.2	**Emergency Communication** - Investigate the establishment of a formal process for disseminating system information to the Generation Owners during a system disturbance enhancing the current process and procedures in place at the NYISO and at the TOs.	1	Procedures to be developed following completion of implementation plans for recommendations under Area 3.3 (Coordinated Emergency Response).	

NYISO RWG Recommendations continued ...

No.	Recommendation	Action Steps	Actions	Action Taken
3.4.3	**Emergency Communication** - Improve communications with all parties affected, including TOs and neighboring control areas. It was agreed that additional communbication was needed to better disseminate information concerning the state of the control area and the control areas around the NYCA.	1	Procedures to be developed following completion of implementation plans for recommendations under Area 3.3 (Coordinated Emergency Response).	
3.5.1	General Recommendation - Determine if NYISO load shedding protocols during periods of system restoration or normal operations should be modified.	1	A proposal to change the ratio of load shedding requirements for each TO which is based on actual load instead of peak load will be sent to the SOAS by September 2004. This change will apply to both normal and emergency operating conditions.	At the August 25, 2004 SOAS meeting, a proposal was made to retain the current load shedding procedure for normal/emergency operations but to develop a new methodology for operations during a restoration state. Revisions to the NYISO E&O Manual were reviewed at the October SOAS meeting. The revised manual will be posted for a 30 day review period and is expected to brought before the NYISO OC for approval in November 2004.
3.5.2	General Recommendation - Ensure that TO restoration plans are coordinated with the NYISO's restoration plan.	1	This recommendation will be addressed once implementation plans are completed for all recommendations under Area 3.2 (Operator Training Enhancements).	
3.5.3	General Recommendation - Investigate the extension of TO and NYISO EMS/SCADA points on critical tie-lines allowing the operators to look several busses into the neighboring control area TO networks.	1	CDAS has been assigned the lead role in implementing these modifications. RWG will track progress and provide periodic status reports to SOAS until the task is completed.	NYISO has received additional data points outside of the NYCA to improve the wide area view.
3.5.4	General Recommendation - Investigate relay practices on control area ties, specifically reclosing schemes and the impact on restoration events.	1	SPAS has been assigned the lead role in implementing these modifications. RWG will track progress and provide monthly status to SOAS.	SPAS has been coordinating the NY TO response to NERC Blackout Recommendation #8a - "Transmission Owners to evaluate Zone 3 relay settings on all lines 230 kV and above". Responses are due at NERC by 12/31/04.

APPENDIX C

List of Industry Acronyms

Acronyms

Blackout Final Report

ACE	Area Control Error
AEP	American Electric Power
CSC	Cross Sound Cable
DAM	Day-Ahead Market
DFR	Digital Frequency Recorder
DOE	Department of Energy
EDRP	Emergency Demand Response Program
EDT	Eastern Daylight Time
EMS	Energy Management System
FE	FirstEnergy
FERC	Federal Energy Regulatory Commission
GOTS	Generator Operator Training Seminar
HQ	Hydro Quebec
Hz	hertz
IMO	Independent Market Operator (Hydro-Ontario)
IRCWG	Inter-Control Area Restoration Working Group (NPCC)
ISO	Independent System Operator
ISO-NE	Independent System Operator – New England
kV	kilovolt
LBMP	Location Based Marginal Pricing
LIPA	Long Island Power Authority
MW	Megawatt
NERC	North American Energy Reliability Council
NMPC	Niagara Mohawk Power Corporation
NPCC	Northeast Power Coordinating Council
NYC	New York City
NYCA	New York Control Area
NYDPS	New York Department of Public Service
NYISO	New York Independent System Operator
NYISO RWG	New York Independent System Operator Restoration Working Group
NYPA	New York Power Authority
NYPA ECC	New York Power Authority Energy Control Center
NYSDEC	New York State Department of Environmental Conservation
NYSRC	New York State Reliability Council
PJM	Pennsylvania, New Jersey, Maryland Interconnection
PSE&G	Public Service Electric and Gas
RTO	Regional Transmission Organization
SCR	Special Case Resources
SCUC	Security Constrained Unit Commitment
SOAS	System Operations Advisory Subcommittee
SOTS	System Operator Training Seminar
TO	Transmission Owner